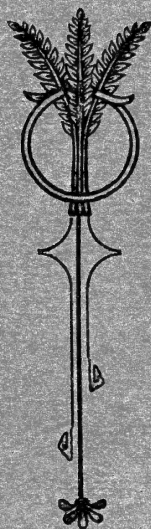


The Evils of Deforestation.



BY

J. P. GROSSMANN, M.A.

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THE EVILS OF DEFORESTATION.



By J. P. GROSSMANN, M.A.,
Director of School of Commerce, Auckland University College.

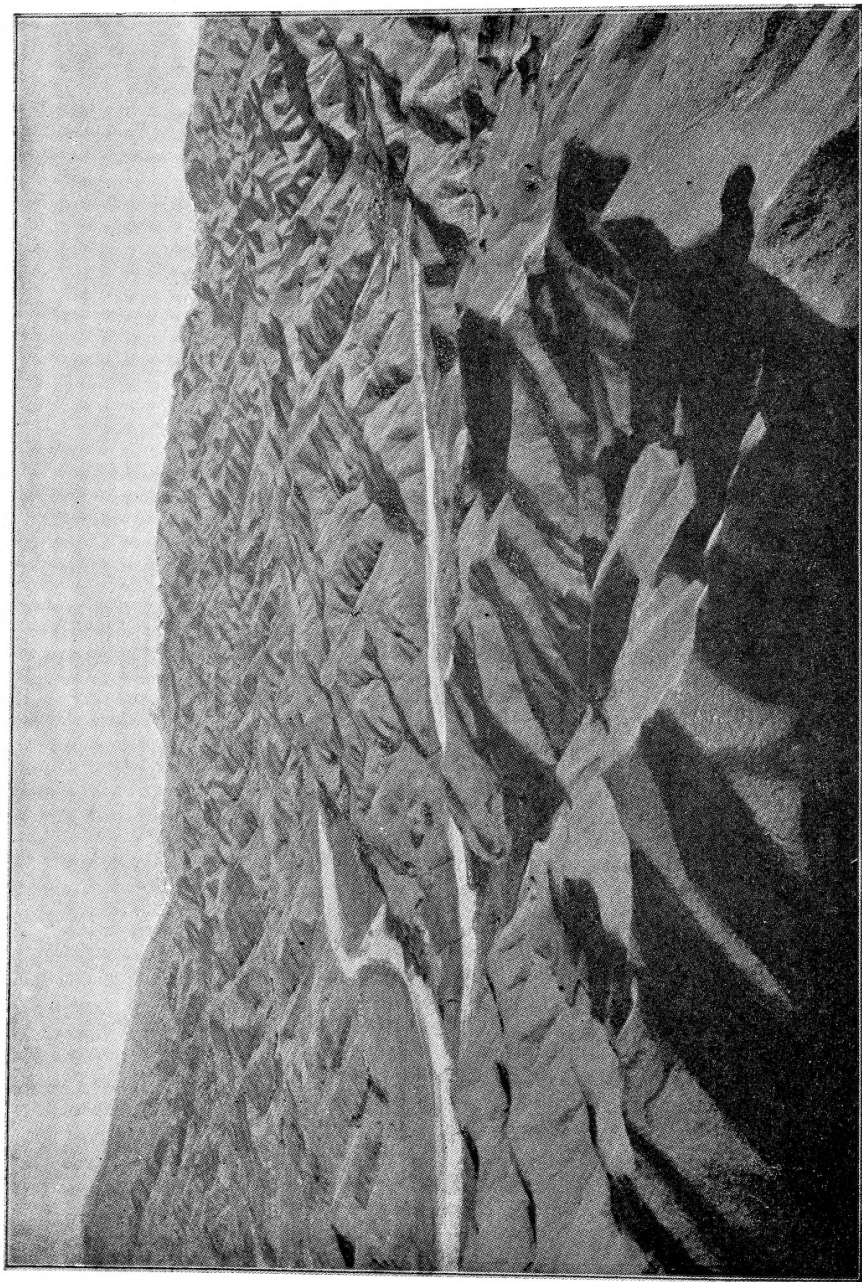
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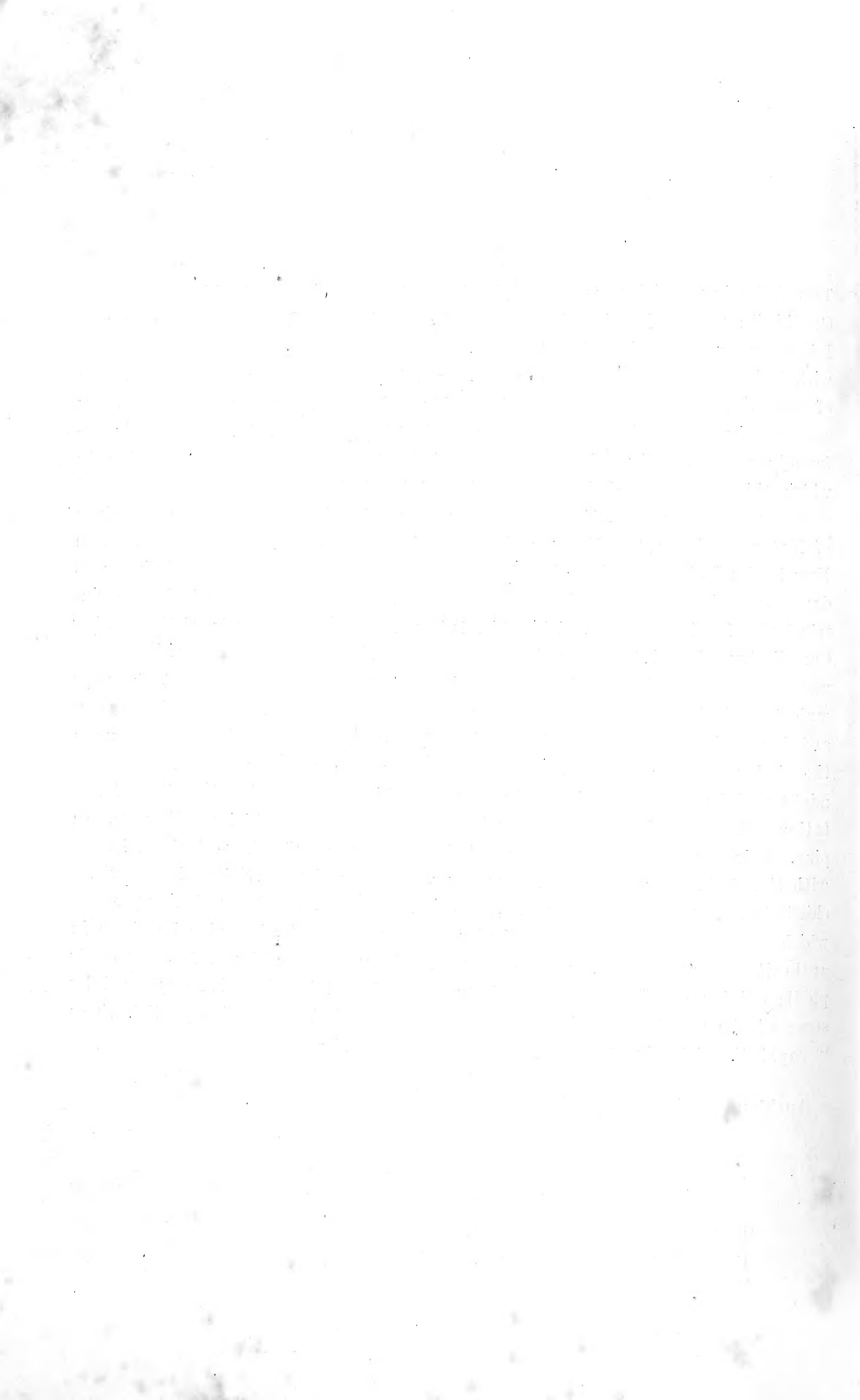


TWO HUNDRED SQUARE MILES RUINED BY DEFORESTATION IN 150 YEARS.
A scene of desolation in North China that will be paralleled sooner or later in every land that destroys
its trees and refuses to replant them.

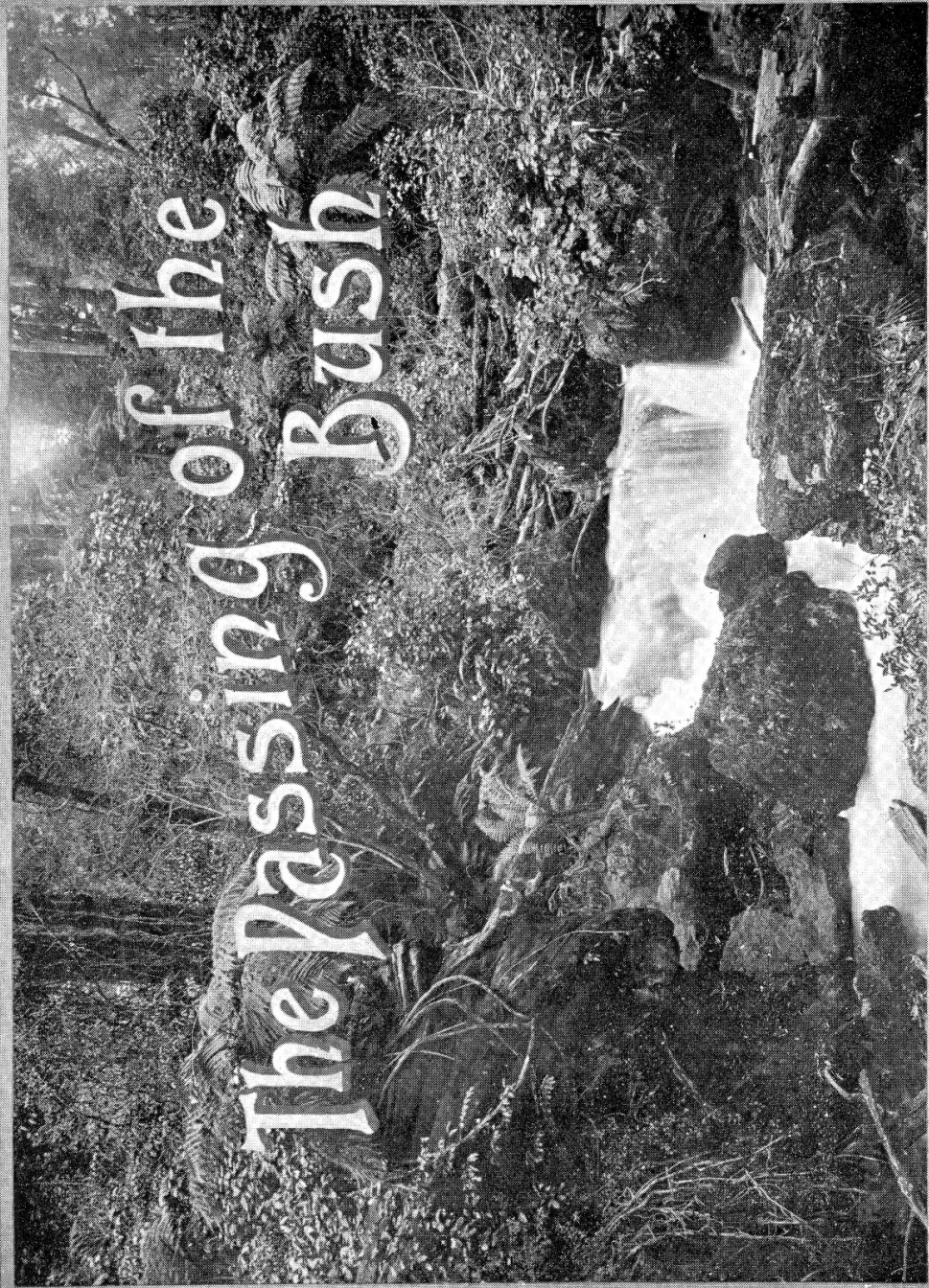
PREFACE.

THE following articles were originally written for the Auckland "Weekly Graphic," and are therefore intended to be of a descriptive and popular nature. I have not attempted to trouble my readers with large masses of statistics or with technical terms and theories. I do not lay claim to any expert knowledge of Forestry, nor can I hope to add anything of serious importance to the large amount of valuable literature already produced on this subject. But I am profoundly convinced that the process of wholesale and reckless deforestation to which this country is being subjected will inevitably produce momentous and disastrous consequences, if we do not take warning in time from the teachings of Natural Science and the experience of older lands. And it happens that in New Zealand those results of Deforestation which are to my mind of the most dangerous character are largely obscured by considerations which are intrinsically far less serious. This fact is illustrated in the records of the Timber Commission which lately toured these islands. Whatever the nature of its report may prove to be, it is quite certain that most of the members and the vast majority of the witnesses examined were very much less interested in erosion and denudation and the climatic results of Deforestation than in its effect upon the timber supply. In fact, the casual reader glancing over the daily reports might well be excused for imagining that the chief questions involved in Deforestation are the market price of kauri and the consequences of importing Oregon pine. I do not deny the importance of these matters; and I have dealt at length with the timber supply in the following pages. But I have written these articles chiefly to draw public attention to those other aspects of the Deforestation problem which are usually ignored, not only by the general public, but also by those in authority over us; and my hope that something may be thus effected to stir public opinion on the subject has been strengthened by the wish expressed by some of the members of the Timber Commission that I should republish these "Graphic" articles in a more compact and durable form.

Auckland University College,
September, 1909.



The Passing of the Bush





EROSION—FIRST STAGE, THE CLEARED HILL SIDE.



EROSION—SECOND STAGE, THE FISSURED SOIL.

I.

THE PASSING OF THE BUSH.

THE object of these papers on the disappearance of our forests and the necessity for replacing them is not so much to supply information as to rouse public interest in a matter of vast national importance, which hitherto has attracted far too little notice here, and which involves most serious danger and irreparable loss to our country if it is any longer ignored. Generally speaking, the Passing of the Bush has been regarded by most people who have thought about the matter in one of two alternative ways, according to the temperament of the thinker. The sensitive and aesthetically-minded folk have thought of the bush mostly as a highly picturesque asset among our manifold scenic attractions, and they have deplored its disappearance chiefly because it means the destruction of natural beauty, which can never be restored. On the other hand, the practical, hard-headed men of the world, whose attention has been called to the subject, have considered the vanishing of our forests chiefly from the standpoint of our timber supply; and they regret the approaching extinction of the kauri and other indigenous trees mostly because it will mean higher prices and heavier cost of production in the building trade and other associated industries. No doubt these views are all important enough in their way; but there are other aspects of the case, which, to my mind, demand far more urgent consideration. It does not seem to be generally understood, or, at least, generally appreciated that the destruction of our forests means a great deal more to us all than the loss of timber or the vanishing of picturesque scenic effects. And it is be-

cause too little attention has hitherto been paid here to the effects of the wholesale destruction of our bush on the climate, the soil, and the fertility and reproductive power of the country that I desire to impress upon my readers with the utmost possible emphasis, the magnitude of the evils caused by deforestation.

WORDS OF WARNING.

I have suggested above that the most important effects of the destruction of bush or forest are those bearing upon the climate, soil, and fertility of the country. There is nothing original in this statement. It may be found in any ordinary geography; but the trouble is that we seldom apply generalisations of this kind to our own case. Yet, so far as New Zealand is concerned, the evils to which I am referring, were long ago officially and authoritatively recognised. There lies before me a copy of a paper on "The Climatic and Financial Aspects of Forest Conservancy as applicable to New Zealand," read before the N.Z. Institute at Wellington in 1877. The paper was written by Captain Campbell-Walker, then Conservator of State Forests for the Colony, and it shows in every page that the dangers resulting from the indiscriminate destruction of the bush were even thirty years ago clearly realised and vigorously impressed upon the minds of our legislators and administrators.

Captain Campbell-Walker deals first with the effects of timber felling on climate, and he finds "a host of evidence tending to prove that the general destruction of forests has rendered climate more trying, less equable, and devoid of sufficient moisture; in short, has caused

it to deteriorate both with respect to its effects upon the health of man and other animals and upon the fertility and productiveness of the soil." He quotes from Marsh's well-known work on "Man and Nature" to the effect that forests "within their own limits and near their own borders maintain a more uniform degree of humidity in the atmosphere than is observed in cleared ground"; and he further illustrates this point from the experience of districts in America, where the forests have been cleared away: "With the disappearance of the forest all is changed. At one season the earth parts with its warmth by radiation to an open sky, and receives at another heat from the unobstructed rays of the sun; hence the climate becomes excessive and the soil is alternately parched by the fervour of summer and seared by the rigours of winter. Bleak winds sweep unresisted over its surface, drift away the snow that sheltered it from the frost, and dry up its scanty moisture." I have cited Marsh only by way of illustration; for the whole literature of the subject is full of evidence of the same kind. Careful observation in recent years has tended to throw doubt upon the extent of the influence on climate and temperature once attributed to forests. But, on the other hand, there seems to be no doubt that the disappearance of bush and scrub has in many countries, and even in New Zealand, been followed by the failing of springs and the disappearance of rivulets and streams. In the handbook on "Tree Culture in New Zealand," issued by our Chief Forester, Mr H. J. Matthews, this effect is noted as the direct consequence of the efforts made by our settlers to clear bush land. The experience of every country where observations on the rainfall have been carried out—St. Helena and Ascension, Asia Minor and Switzerland, Italy and France, California, the West Indies and Australia—all tends in the same direction. "The countless ruins of Palestine," says Mr A. Page in a recent issue of "The World's Work," "the stony hills and de-

serted valleys, are the result of maltreatment of the land that once flowed with milk and honey. Mesopotamia, one of the most sterile countries in the East, was once a forested and fertile land, and the Euphrates river is now swallowed up in the desert. Greece shows a similar decadence. Sicily, which when covered with forests, was the granary of Rome, is now entirely deforested, and even when undisturbed by earthquakes is a poor agricultural country. There are parts of Denmark, Bohemia, Hungary and Austria which in modern times have become valueless through deforestation. The Chinese have ruined great parts of their Empire by destroying their forests, and they are fast becoming waste places in which no man can live." Evidence of this kind might be multiplied indefinitely, but this may be sufficient to suggest the importance and value of forests in maintaining a country's water supply and the danger involved in the cessation or diminution of the streams and springs on which its fertility and productivity so largely depend.

But this question of the water supply is closely connected with another and even more important aspect of deforestation. Professor Schwappach, in his text book on "Forestry," points out that, apart from the fact that forests are constantly adding valuable organic matter to the soil, they have a directly beneficial effect upon it in other ways:—

(1) They prevent the sunlight and heat from reaching the soil directly, and thus searing or burning it.

(2) They break the force of the wind, and so save loose soil from scattering or drifting.

(3) They reduce the mechanical force of heavy rain.

(4) They bind together and keep in its place soil that would otherwise be carried away by floods.

It is on the last two of these effects that I wish more particularly to dwell, and I believe that evidence can be produced on these points that will convince any intelligent person that the destruc-

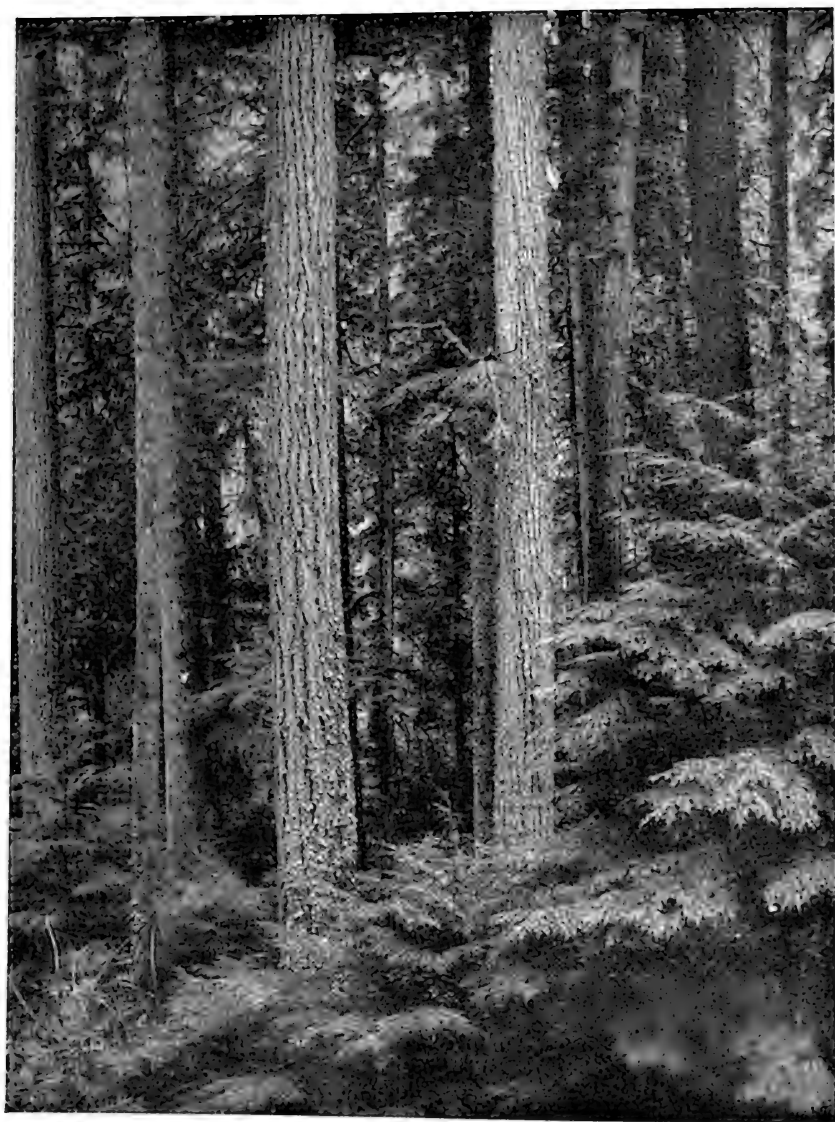


EROSION NEAR PEKING — THE FERTILE LAND BURIED
BENEATH STONES AND SHINGLE.



STONE WALL TERRACING IN THE WU-TAI MOUNTAINS IN
NORTHERN SHANSI.

The only way to save the land and protect the streams after the forests have been cut away.



WHERE THE OREGON PINE GROWS.

tion of forests in these respects exercises a terribly baneful influence upon the country that has once, prodigal-like, sold its birthright of trees without making any provision to repair their loss in the future. To put it briefly, the worst effect of deforestation is

EROSION.

To estimate the full significance of this term, we must consider briefly the part played by trees in all natural systems of drainage and water supply. Here I may quote Professor Schwappach again: "The water from heavy rains, checked in its descent by meeting first with the foliage of trees, is better retained on forest soil than on bare land. Under a close cover of trees, there collects a 'humus' soil formed from the decay of fallen leaves. Through this sponge-like soil-covering the rain water slowly filters, and its passage is further retarded by the stems and roots of the trees. In this way the erosive effects of violent rains upon bare hillsides is obviated. This is often a very serious danger, not only because the good soil is washed away, but also on account of lower-lying fertile lands being covered by boulders, gravel, and sand brought down in the flooded waters." With this statement of the case, we may compare the following extract from Captain Campbell

Walker's paper, which, as mentioned above, bears more especially upon the effects of deforestation in this country. "The forests by their presence act as storehouses of moisture, both from their leafy canopy which covers the earth, and the bed of dead leaves on its surface, the loss of moisture by evaporation being by these means reduced to one-fifth; and, further, the bed of dead leaves acts as a sponge soaking up and retaining the rain and regulating its distribution, while the roots not only act as vertical drains promoting the descent of the water into the lower strata of the earth, there to nourish the springs, but bind the soil on the mountain sides together, and prevent its being carried away into the valley below." It should now be clear what difference forests make to a country's river system and its soil. They store up water for gradual distribution; and they prevent the vegetable mould they form from being washed away. Consequently, it follows that when the bush is cut down, not only do streams tend to disappear with it, but the rain, when it comes, carries the fertile soil from the hillsides down into the valleys, and at the same time, rushing unimpeded along the channels and courses that the storm-water has already excavated in the earth, causes sudden and disastrous floods.

The Price We Pay





A VALLEY AT THE FOOT OF DEFORESTED HILLS IN
NORTHERN CHINA.

The land ruined for crops except where stone walls catch some sediment during
the floods.



CHINESE MOUNTAIN RANGE DEFORESTED SINCE 1725.

Terracing to save the soil.

II.

THE PRICE WE PAY.

FOREMOST among the inevitable effects of deforestation we must, therefore, rank floods and landslips. It must be clearly understood that this description of the effects of bushfelling is by no means simply theoretical. Unfortunately, the theory has been illustrated in only too literal and practical a fashion in all the countries that have ever been endowed with great natural forests. In America this question has already assumed the dimensions of a great national problem, and the disastrous results of erosion are dwelt on impressively in the report recently presented to Congress by the National Conservation Commission. "One small neglected stream," we are told, "has been found by actual measurement to wash enough soil from its hills to deposit silt equal to one and a-half tons per acre of its watershed in a year. The quantity of silt deposited every year by all the streams in the United States would cover a territory nine hundred miles square a foot deep. Our rivers have washed 783 million tons of the best soil of the United States from the upland farms and carried it into the rivers, where it has formed bars, impeded navigation and finally lodged in the great harbours. The Government has already spent 553 millions of dollars for river and harbour improvements," and this outlay has been rendered necessary almost entirely through the indirect effects of deforestation. The Commission estimates that soil erosion reduces farm production from 10 to 20 per cent.; and that the annual loss to the farms alone is 500 million dollars. The direct damage from floods has increased from 45 million dollars in 1900 to 238 million

dollars in 1907—and all this enormous expenditure and loss is attributed by this responsible Commission of experts to the reckless slaughter of the forests.

LANDSLIPS AND FLOODS.

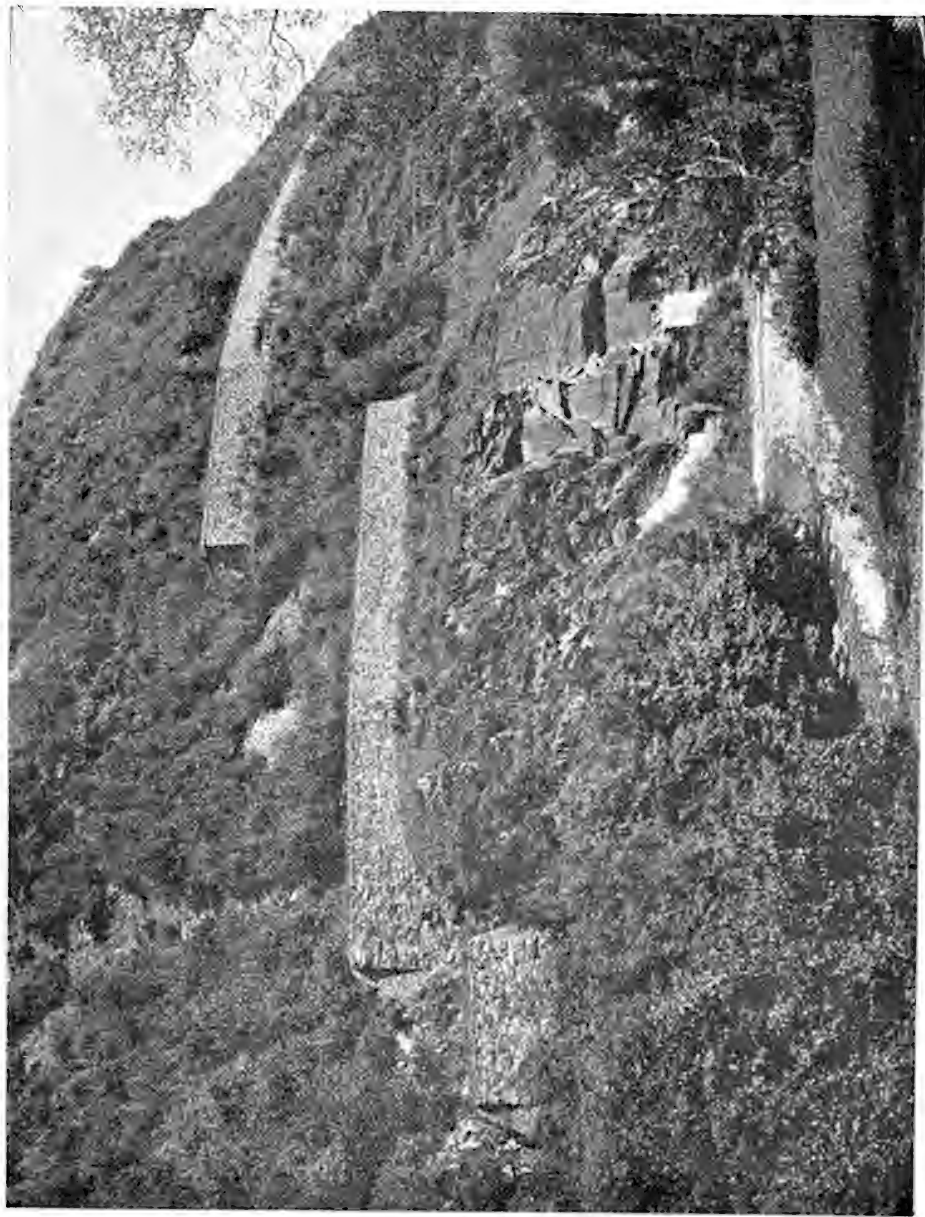
This conclusion is supported by a host of other witnesses. Mr. A. W. Page, in an article on the "Statesmanship of Forestry," points out that the Colorado in flood time carries down 1000 tons of mud a minute, simply because all the trees have been cut away on its watershed. "Rivers whose headwaters have been deforested are beginning to carry mud in this way, building up banks and bars, changing their courses and ruining navigation"; and most of the trouble with the Mississippi which is now to be deepened and straightened at a colossal cost, is due to deforestation. In two months in 1905, the floods on the Catawba River, we are told, did a million and a half dollars' worth of damage. When they subsided some farmers found sandbanks ten feet deep on their fertile acres. Mr. Stewart White, the famous novelist of the North, says that 18 million acres of farm land have been lost in the Appalachian district in a few years by erosion alone. Ten years ago Professor Shaler, of Harvard University, estimated that 3000 square miles of soil had been washed from the slopes of the Southern Mountains on account of the destruction of the forests. The upper valleys of the rivers are becoming subject to violent freshets, and the lower valleys to great overflows which have to be controlled by costly levees. And the destruction so far, adds Mr. Page, "has been only enough to give an imaginative man a conception of what floods will come from those mountains if all their forests are

ever cut down." But unhappily it is not necessary to limit ourselves to conjecture as to what may happen in extreme cases of this kind. In at least one country in modern times we have seen exemplified on the largest conceivable scale the terrible consequences of defying the ordinances of Nature by destroying the forests and neglecting to replace them. "China," writes Mr. Emerson Hough, dealing with "The Slaughter of the Trees" in "Everybody's Magazine" (May, 1908), "is the best instance of a land that never cared for forestry. She builds houses now of little poles, uses for fuel saplings, shrubs, herbage. Her children literally comb the hillsides for bits of roots and shrubs for fuel and fodder. The land is bared to the bone. It is a land of floods. Villages are swept away, hard-tilled fields ruined. Starvation always stalks in China. Alternate floods and water famines follow the waste of forests." The most striking illustration of these evils in the history of China is the record of the Hwang-Ho, the great Yellow River which drains the Northern Provinces, and twice within the last forty years has flooded vast areas of densely peopled country, destroying millions of the inhabitants in a few hours. In the great flood of 1868, and again in 1887, the Hwang-Ho is credited with something like seven million victims; and considering that the floods covered ten thousand square miles of territory, studded with 3000 villages, the estimate is probably not excessive. Possibly the illustrations to this paper—some of which were submitted to Congress by President Roosevelt, with his last Message, in which he dealt with the necessity for reforesting the United States—may give some faint idea of the ruin and desolation that thus inevitably follow the Passing of the Forest. In China the work of destruction is still going on. The Hwang Ho is periodically flooded, and millions of lives are sacrificed simply because the forests in Northern China have been cut down and never replaced. "They cut off the trees

then the shrubs, then the grass until not a single living thing remained on the mountain sides. The rain washed the soil from the rocks. With infinite patience every year they build terraces wherever they can to save a little of the soil for agriculture. The once fertile valley lands are covered with gravel and rocks, the debris of floods. The territory that was once fertile is now bare, its flourishing cities are falling into decay, the land is becoming uninhabitable." And all this devastation and waste of property and life, and this destruction of man's handwork have been due to the reckless cutting down of forests. The picture of desolation that some of these illustrations reveal may stand as a general type of the effects of deforestation in all countries in varying degrees. The loss of fertile soil, the submergence of productive land under a superincumbent load of barren debris and detritus from the hillsides, the choking of river beds, the diversion of rivers from their courses, and the disastrous floods that inevitably follow such changes—all these evils are in every land the direct consequence of the wholesale extirpation of timber trees.

WHAT OTHER COUNTRIES SUFFER.

It would be easy to accumulate great masses of evidence of a character similar to the foregoing, but I may content myself with a few typical instances. In Stanford's "Compendium of Geography and Travel," I find the following reference to Cyprus in regard to deforestation and its effects:—"The disappearance of the woods, now reduced to about 400 square miles in the southern uplands, has seriously affected agricultural prospects. With the forests went the soil which was washed down to the plains, choked the river beds and formed malarious swamps; the hills became bare rocks incapable of growing a blade of grass, and the locust at once took possession of the barren ground; whilst the absence of trees deprived the earth of its annual fertilising leaf mould. There is now a stony desert at the S.E. end



THE SLIDING HILLS.

Where the soil must be kept up by stone walls after the trees are cut away



of the island, where tradition says there was formerly a large forest." The same story might be told even more forcibly of Asia-Minor, once the garden of the world, filled with densely-peopled towns, now for the most part treeless, waterless, sterile, and almost depopulated. Of Spain it has been said that the loss of her wealth and power, and the decay of her Empire, were due more than anything else to the impoverishment of her soil through the destruction of her forests. Describing Central Spain Sir A. Ford writes: "The denuded tablelands are exposed to the fierce suns of the summer and to the fiercer snows and winds of winter, while the bulk of the peninsula offers a picture of neglect and desolation, moral and physical, which it is painful to contemplate. Extensive steppes and plains are burnt by the sun in summer and swept by the icy winds in winter; while rain is so rare in the tablelands that the annual fall does not exceed 9 inches, and there are districts on which no shower descends for eight or nine months together. The face of the earth is tanned tawny, and baked into a veritable 'terra cotta,' and everything seems dead and burnt as on a funeral pile." Mr G. Chisholm, one of the most eminent of living geographers, describing the basin of the Po, in Northern Italy, says of the risk of floods to which it is constantly exposed:—"These dangers have been much increased by the wanton destruction of the forests of the Alps and Apennines, for when the shelter of the woods is gone, the heavy rains of summer easily wash the soil from the slopes down into the rivers, and many an upland pasture has by this process been turned into bare rock." Referring elsewhere to the malarial swamps in North Italy, the same authority writes:—"Since ancient times, the extent of marsh has in many places been increased through the excessive clearing of mountain forests, causing rain-water to rush unchecked down the mountain sides, and the rivers to swell into devastating floods."

THE CASE OF FRANCE.

But perhaps the best illustration of the evils and dangers to which all countries are exposed by the process of deforestation is to be found in the meteorological and topographical history of France during the past century. Dr. Croumbie Brown, in his work on "Reboisement (reforestation) in France," gives a complete account of the causes that led to the clearing of the forests in the Lower Alps and the Pyrenees, and the results that followed in the form of landslips and floods. The details that he gives of the devastations committed by the mountain torrents, augmenting every year with the cutting out of forest and undergrowth form a picture that has been truthfully described as appalling. "The disappearance of the forests from the mountains," writes Captain Campbell-Walker, "gave up the soil to the action of the waters which swept it away into the valleys, and then the torrents, becoming more and more devastating, buried extensive tracts under their deposits, tracts which will probably be for ever withdrawn from agriculture." And not only has irreparable injury been thus inflicted upon the country, but enormous losses of property, and even of human life, have been sustained as a direct consequence of these same baneful causes. During 1875 the loss of property in the South of France through floods was estimated by the State at £3,000,000, and in addition at least 3,000 people lost their lives. "The indirect results in the shape of temporary or permanent damage to agricultural districts by the deposit of stones and shingle brought from the mountains by the flood waters cannot be estimated, still less the damage to pastoral lands on the mountains themselves. It may be stated generally that the results of excessive clearing of forests and abuse of pasturage on the French Alps and Pyrenees have reduced their capacity as a sheep and goat carrying area to such an extent that they cannot feed half the stock that grazed

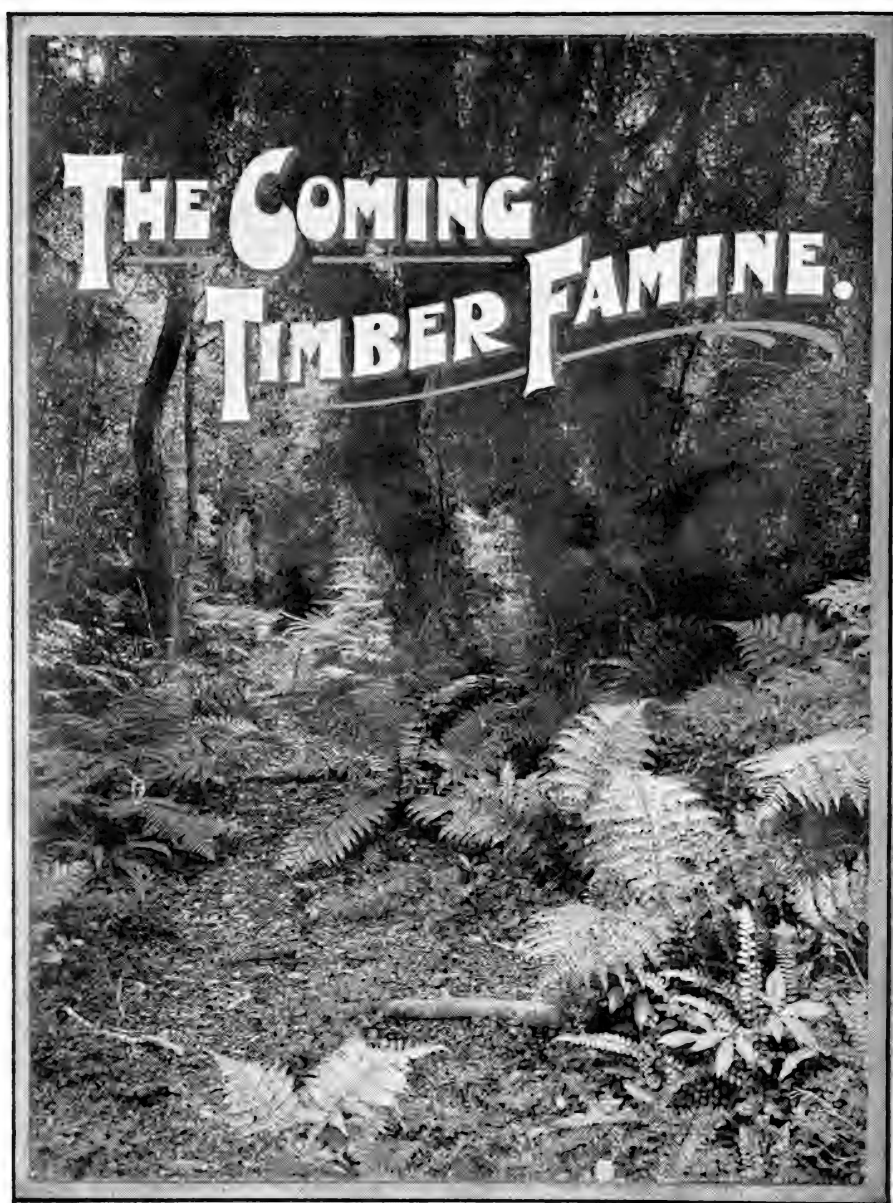
there fifty years ago; whilst the damage resulting to the agricultural districts below from the drying up of springs and streams, the torrents caused by heavy rains, and the melting of the snows and their effect on the river banks and channels followed by long droughts in summer is simply incalculable, and such as cannot be repaired, even at a large expenditure within two generations." This was written over thirty years ago, but it is as true to-day as it was then, and the moral to be drawn from it applies not more directly to France than to any other country in which the same conditions and causes are already developing the same inevitable series of consequences.

COSTLY REMEDIES.

That the injury thus sustained is real and serious is sufficiently established by the strenuous efforts made in various countries to cope with the evil of deforestation. The harm done by the reckless destruction of forests has been manifested perhaps more clearly in France than elsewhere, and the French Government has made the most vigorous exertions to remedy the evils produced by the neglect of centuries. The system known as "reboisement" will eventually result in re-clothing with forest all the denuded mountain ranges in the south-eastern districts and departments of France. Commencing with the most important points—the sources, head waters and upper reaches of streams, and the gullies extending up to the lofty ridges where water is precipitated from the clouds or accumulated from the melting snows—systematic re-planting has been carried on for a considerable number of years, with results that at least justify the Government in prosecuting the work on a constantly expanding scale. Many years ago Surell, in his work on Alpine moun-

tain streams, described the condition of the deforested regions of Southern France, Italy and Switzerland as almost hopeless. "The country is becoming depopulated day by day. Ruined in their cultivation of the ground, the inhabitants emigrate to a great distance from their desolated lands, and contrary to the usual practice of mountaineers, many of them never return. There may be seen on all hands cabins deserted or in ruins, and already in some localities there are more fields than labourers. The precarious state of these fields discourages the population left. They abandon the plough, and invest all their resources in flocks. But these flocks expedite the ruin of the country, which would be destroyed by them alone. Every year their number diminishes in consequence of want of pasture grounds. Thus the inhabitants who sacrifice all their soil for their flocks, will not leave even this inheritance to their descendants." It is clear that where this goes on unchecked it means the absolute and irretrievable ruin of a region so affected; and the magnitude of these disasters indicates also that nothing but a very heavy annual expenditure, continued over a long series of years—perhaps for a century or more—will even stay the process of destruction, to say nothing of repairing the losses and restoring the land to anything like its original fertility. Such a prospect might well discourage the wealthiest and most enterprising of States if their efforts were not stimulated by another motive that appeals to them perhaps quite as effectually as the instinct of self-preservation roused by the losses and injuries that I have attempted to describe. I refer to the growing scarcity of timber resulting from the ceaseless destruction of the world's invaluable stock of forest trees.

THE COMING
TIMBER FAMINE.



III.

THE COMING TIMBER FAMINE.

VERY few people have any conception of the enormous demands that are constantly made upon the world's available stock of timber, the extent to which the existing supplies are being annually diminished, and the extraordinarily serious consequences that must ensue if nothing is done in the near future to grapple with the emergency thus created. It is generally known in New Zealand that our kauri is within measurable distance of extinction, and that many of our most valuable indigenous trees cannot long hold out against the constantly increasing demand. But even the people most directly interested in our sawmills or in the importation of Oregon pine do not seem to realise that the shortage in our timber output is merely a single phase of a widespread falling off in the world's supply of timber, and that in no long period of time we will be unable to replenish our stock by importations from other countries except at a ruinous cost. "Will there be a timber famine?" asks Mr. J. H. Young in a recent issue of the "World's Work" (Eng. ed.), and his answer to this momentous question opens in the following ominous terms:—

FACTS AND FIGURES.

"The alarming rate at which the world's supply of timber is being depleted is causing the gravest anxiety to those who are interested in afforestation, and many authorities on timber-growing affirm that unless the State undertakes some scheme of silviculture, the very existence of the many industries dependent upon our wood supply is bound to be seriously imperilled in the future." This warning is directed more particularly to the United Kingdom, but unfortunately it applies quite as emphatically to nearly every other country in the world. In one

sense it is quite unnecessary to pile up huge masses of statistics to illustrate what must be a sufficiently obvious truth. For it is self-evident that the forest resources of the world are not illimitable, and that if they are continually being cut down without being replaced, the day must come sooner or later when the demand for timber will no longer find means to satisfy itself. This is, of course, a mere truism, but like many other truisms it is not sufficiently appreciated by people in general, and this must be my excuse for labouring a point that certainly needs very little corroborative testimony. However, it may help to drive the argument home if I add here a few figures bearing on this question of the diminution of the world's timber stock, quoted from an interesting article that appeared recently in the Melbourne "Age." "The world's timber supplies are rapidly diminishing, and in almost every country the circumstance is causing an apprehension bordering on consternation, for the demand for timber all the world over is steadily and speedily augmenting. It was estimated not long ago by an Afforestation Committee in Britain that if the present rate of consumption is maintained the timber supplies of Europe and America will be exhausted in another twenty years. Britain annually imports 5,000,000,000 superficial feet of timber, and her consumption, according to the latest available returns, increased in 1906 by 633,000,000 feet. Germany has a well-organised Forest Department, and one-fourth of her area is under forest; nevertheless she imports nearly 3,000,000,000 superficial feet per year. France has one-fifth of her area under forest, and she employs 3000 officers in the work of timber conservation and reafforestation; yet France imports 738,000,000 feet

of timber annually. The greater sources of supply for these countries are Northern Europe, America, and to a small extent New Zealand. But the enormous pine forests of Northern Europe are now almost denuded. New Zealand has 30,000,000,000 feet of timber still available, but it is diminishing at the rate of 430,000,000 feet a year. And America, comparatively speaking, is no better off. Throughout the United States the total quantity of marketable timber in 1906, according to the departmental calculations, was 2,000,000,000,000 superficial feet. But America has 21,000 sawmills at work, which are cutting the enormous quantity of 37,500,000,000 feet per annum. It is obvious, therefore, the "Age" concludes, "that the world's timber outlook is very serious, and a shortage of supplies within the next couple of decades appears to be inevitable."

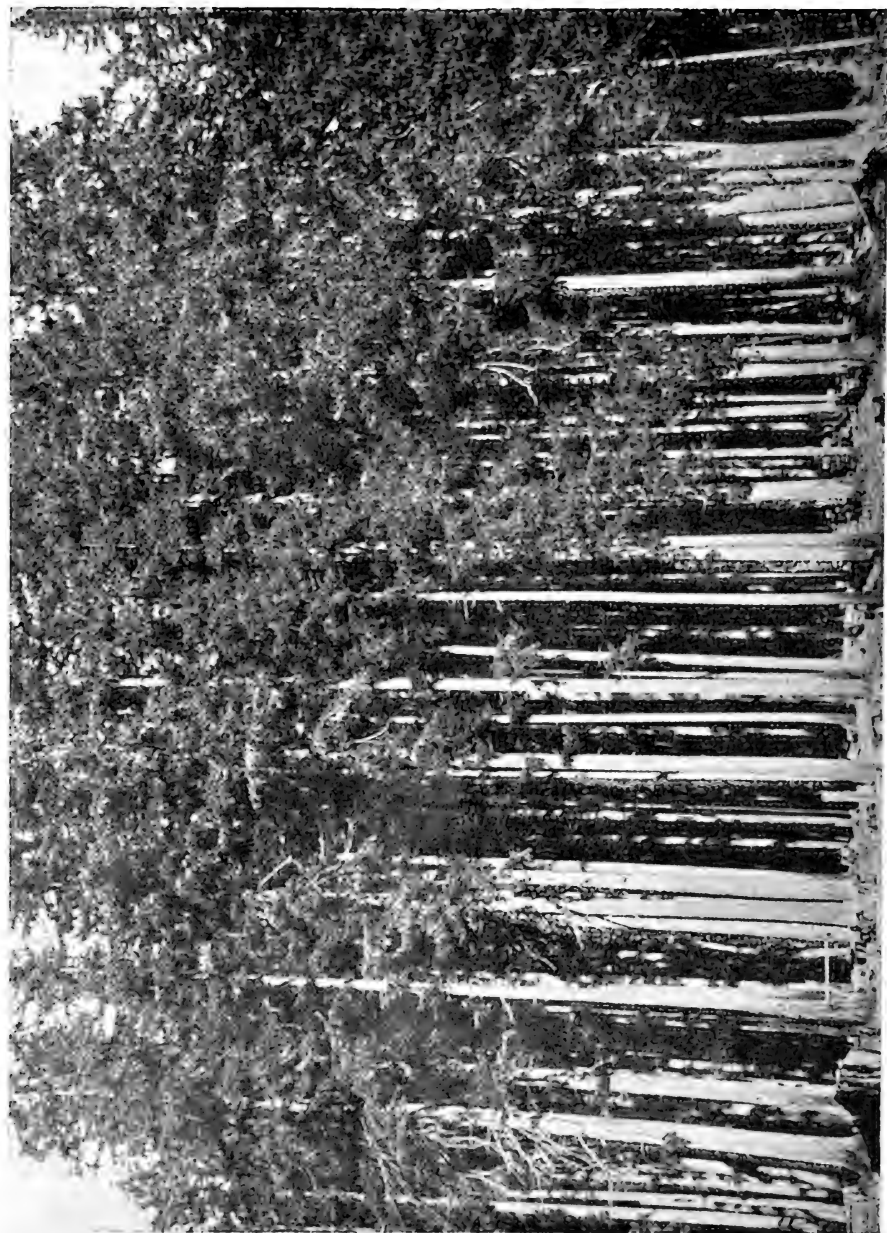
THE COMING CRISIS.

"I may supplement these facts with a few further extracts from the article on "The Coming Timber Famine," by Mr. J. H. Young, to which I have already referred:—"The tremendous strain upon Russia's timber forests has been, and still is, of such a vast nature that the country will not long be able to supply the wants of outsiders. Norway a few years hence will be almost equally crippled. Indiscreet cutting down of millions of tons of timber in years past, with little or no preparation for the future, is already telling a tale. . . . Twenty-five years hence at the present rates of cutting, the timber supply of the United States will cease. Britain alone receives £3,000,000 worth of timber annually from America, but the rapid increase in the population points to a not far distant day when it will be only able to supply us with little more than half that amount. The once magnificent forests of the United States have been enormously reduced within the last few years, and as the demand for a considerable time has been 25,000,000 tons ahead of the natural supply, the process of extermination goes remorselessly on. . . .

Canada hitherto has materially helped to make good the deficit in America's timber supply; but here, again, the march of civilisation is making itself felt. The vast and ever-increasing population that has poured into Canada within the last few years has resulted in immense forests being cut down to make room for agriculture"; and in Canada, as well as throughout the United States, an ever-present and assiduous enemy is at work in the shape of "the devastating fire-fiend, the blighting irrepressible flames of which are responsible for the destruction of ten times more trees than those felled by the axe." It is true that before the timber famine actually becomes acute, the vast forests of Central and South America, of Central Africa, and North-Eastern Asia will be requisitioned, and will help to avert the evil day. But all this evidence tends emphatically to confirm the opinion already advanced that the world's supply of timber is no longer equal to the demand, and that unless existing conditions are radically altered, a very few years will bring us all face to face with a most serious crisis through the universal scarcity of one of the indispensable necessities of progress and civilisation.

WHAT IT MEANS TO US.

To realise what this coming timber famine may mean to the world at large, we have only to consider the countless uses to which timber is now applied. "In almost every undertaking, great or small," Mr. J. H. Young reminds us, "timber plays a more or less conspicuous part, and for numerous industries it is quite impossible to supplant it with any other substance. Thousands of tons are swallowed up every year for pit-props in mines; railway sleepers constitute a demand that must run up a big bill per annum, not to mention the many other uses for which wood is absolutely essential in the equipment and working of railways; while everybody, of course, knows that for the building trades timber is the base of their existence." Among the many by-products of the forests we



THE NEED OF SYSTEMATIC FORESTRY.

An Oregon Pine forest in Washington, badly needing scientific cutting.

may mention paving-blocks, dye-stuffs, tanning material, which all represent a heavy drain upon our resources; while for resin and turpentine immense quantities of trees are annually destroyed. But tremendous as is the expenditure of timber on these purposes, it falls far short of the enormous amount utilised every year in the manufacture of paper. "The United States alone use 8,000,000 tons of wood annually for this purpose; over 2,000,000 tons are used by Germany, 1,000,000 tons by Canada, over 1,000,000 tons by Sweden, 200,000 tons by Russia, while Britain's bill for wood pulp in 1908 was very little short of £3,000,000." An ingenious American has figured out that a big paper like the "Chicago Tribune" uses 200,000lbs of paper each Sunday, and 400,000lbs. for the week—in other words about 40 acres of forest for one week's work. Perhaps this fact is enough to give some faint idea of the constant depredations that the progress of civilisation makes in this respect upon the resources of Nature.

THE CASE OF AMERICA.

It is important to observe that we are gradually creating a condition of things that has never been paralleled since the first advent of human life on this planet. Marsh and other distinguished authorities have pointed out that all the available evidence indicates that the habitable earth was originally covered by dense forests in almost every portion. The inroads made by man upon the natural bush were at first of slight importance, and easily repaired; and it is only within comparatively modern times that the accumulated effects of his reckless destruction of the forests have begun to produce any pronounced diminution of the available timber supply. But with the great industrial and commercial changes, and the marvellous improvements in transport facilities that marked the course of the last century, the ravages of Man have told with ever-growing rapidity upon the forests, and the rate of destruction increases every year. Nowhere in the world are these important facts so clearly

evidenced as in America, once regarded as an absolutely inexhaustible source of supply. But if the Americans themselves estimate the position accurately, they will soon have too little timber on hand to supply their own immediate needs. "We have reaped our forests," says Mr E. Hough in the article I have already cited on "The Slaughter of the Trees; "we have reaped our forests as sheep reap the grass lands, leaving nothing behind to grow. We have used ever-increasing appliances for speed and thoroughness to supply an ever increasing demand at an ever-increasing price. We are converging in ever-increasing numbers with an ever-increasing zeal upon what is left; and in our haste to get it all, we are permitting an ever-increasing waste and ruin of the original supply." The falling-off in the reserve stock of timber is plainly indicated by the constant inclusion of forest trees once deemed worthless in the list of industrial woods. Among American hardwoods are now classified beech, sycamore, gums, "anything that will saw into a board." On the Pacific coast only the finest redwood was first cut, then the Douglas fir or Oregon pine, now the hemlock, cedar, "anything that will hold a saw blade." In seven years, it is said, the production of hardwoods in America has fallen off 15 per cent.; and according to Mr Hough, "it will take us 16 years to use up all the rest of our hardwood if we do not burn it and if the demand remains the same." Unfortunately, the one thing certain is that the demand will increase. Moreover, it is almost equally certain that much of the existing supply will be destroyed by fire. "Of all the timber now left standing in America to represent our entire future supply, the lumberman will use less than one-half. The other half will never be taken out of the woods at all. Three-fourths of that half may never be cut, but may be set on fire and burned as it stands." There are about 450,000,000 acres of commercial timber left in the United States, bearing about 2,000,000,000,000 feet of marketable woods. But experts say that the yellow pine will last hardly 15 years at the present rate

of consumption, and that the Douglas fir or Oregon pine will not stand more than 25 to 30 years of the present demand. In the whole United States more than 100,000 acres of timber are cut over every working day; and taking into ac-

count the losses occasioned by fire, it is evident that unless something is done to retard the rate of consumption or to replenish the supply, America's stock of timber must soon near the point of absolute annihilation.

*Can we save the
Bush?*





THE GROWTH OF CENTURIES VANISHING IN SMOKE AND FLAME.

IV.

CAN WE SAVE THE BUSH?

IT is difficult to give any idea of the enormous consumption of timber now indispensable for our industrial and commercial progress, and for the needs of civilised life. In America alone, in 1907, 40,000,000,000 feet of timber were cut for various purposes. The railroads alone need 100,000,000 ties or sleepers a year, which means the cutting of one million acres of hardwood per year for this purpose alone. In 1906, at least three and a-half million telegraph poles were cut in America, three-fifths of them cedar—and the annual expenditure of timber in telegraph and telephone poles in this one country means the clearing of nearly 4,000,000 acres of land. In 1906 again, America used 1,370,000 cords of bark for tanning, nearly 12,000,000 shingles and 4,000,000 laths; and the timber for use in the mines alone amounted to 165,000,000 cubic feet. For paper-pulp something like a million acres a year must be cut to keep the newspapers and magazines going. Even the lead pencils made in the United States consume over 7,000,000 cubic feet of cedar a year, and at the present rate the cedar supply will not last more than 12 years. And with the growth of population and the progress of settlement this demand must inevitably increase. Mr. A. W. Page tells us that unless some radical protective measures are taken, twenty years will see the end of the United States forests. And it is easy to imagine the consequences that will ensue to all the multifarious trades and interests concerned in the use of timber long before the actual famine point is reached. "Some time before the forests disappear cross-ties, mine timbers and wood-building materials will be prohibitive in cost. The price of hardwood has already risen from 25 to 65 per cent" and in

view of the fact that the demand for wood is increasing in every country every year, Mr. Page regards the timber outlook in America as gloomy in the extreme.

I have dwelt at some length upon the position of the United States because America originally possessed what appeared only a few years ago to be inexhaustible supplies of timber. But the demand has increased with such appalling rapidity of late that in the opinion of the most competent authorities the end is already in sight. The weakness of all estimates as to the duration of the supply lies in the incalculable factor of "increasing demand"; and no one can predict how much the life limit of the existing stock may be curtailed by increased facilities for transportation, and increased speed in industrial processes, acting in conjunction with the evergrowing demand upon a constantly decreasing supply.

THE WORLD'S PROSPECTS.

I do not intend at this stage to apply these general considerations to the case of New Zealand, but I wish to make it quite clear that the facts I have cited are not peculiar to America. I am aware that there are optimistic people in this country and elsewhere, who refuse to believe in a possible shortage of timber, who talk vaguely about an inexhaustible supply, or who cherish the hope that even if we do go one using up our timber, as recklessly and rapidly as we can, either Providence will intervene on our behalf or some genius will invent a substitute for wood that will enable us to get along without the help of trees. But in so vitally important and so eminently practical a matter as this, it is surely most unwise to base public policy on hazy speculations. The facts are as I have stated in America, and a similar condition of things prevails in various

degrees throughout the civilized world. The able writer of the article on Forestry in the last edition of the "Encyclopaedia Britannica," after a brief survey of the world's failing stock of timber, points out that three countries, Russia, Scandinavia and Canada, have practically to supply the rest of the world with pine wood, and as the management of their forests is by no means satisfactory, "the question of the supply of light pine and fir which form the very staff of life to the wood industries, must become a very serious matter before many years are passed. Unmistakable signs of the coming crisis are visible to all who wish to see, and it is difficult to overstate the gravity of the problem when it is remembered that 87 per cent. of all the timber imported into Great Britain is fir and light pine, and so for most of the other countries." This was written in 1901 and the demand has certainly increased faster than the supply since then. Dealing with the same subject in 1903, Professor Schlich, probably the most eminent living authority on Forestry, points out that between 1894 and 1899 the average price of imported timber had risen about 18 per cent. and that there was every indication that it would rise further. So far as Great Britain's demand for timber is concerned, Professor Schlich held ten years ago that it was becoming more and more problematical then where the required material was to come from. "It is all very well to say that we can pay for the timber we need; but that will not meet the case. When the supplies from outside fall off the rise in price may become prohibitive, and the effects of an insufficiency of material would be disastrous." The chief difficulty, as I have said, lies in the direction of the soft woods and Professor Schlich admits that "a deficiency of supply in the material would be a real calamity for the population of these islands." As to the possibility of substituting iron or steel, or any other material for timber, Professor

Schlich holds that past experience gives very little hope of this solution of the problem. In spite of extraordinary efforts to find some means of replacing timber by iron and steel for structural purposes, very little progress has been made either in England or France or the United States. As the President of the Institute of Civil Engineers said in 1903, the engineers cannot possibly do without a great deal of timber, and he pointed out that after thirty years' effort they had not yet succeeded in substituting steel for wood as sleepers and railway ties. When we consider that a genuine shortage of timber would not only stop railway building, but would practically bring mining everywhere to a standstill, and would at the same time, throw millions out of employment in the building and other allied trades, we begin to realise that the threatened timber famine which unimpeachable evidence seems to show is rapidly approaching, may prove a terrible menace to the progress and prosperity of the world at large.

IS THERE A REMEDY?

Anyone who considers carefully such evidence as I have compiled must be driven to the conclusion that the risk of a timber famine is imminent and real, and that it is the positive duty of all civilised States to face this situation promptly and boldly. I may remind you at once that many European Governments have long since attempted to grapple with this problem in a practical way. But the proof of the inadequacy of their efforts is that, for example, France, with 18 per cent of her area under forest, Belgium with 17 per cent of her area under forest, and Germany with 26 per cent of her area under forest, are all compelled to import timber largely to satisfy their local needs. This fact is sufficient to show that countries like our own, which have so far done little or nothing to cope with the constant drain upon their own natural resources, can expect little aid from abroad when the crisis at last comes. The sole interest



A FOREST FIRE IN THE EASTERN ROCKIES.

Experience has proved that fires in the United States can be kept down, and the loss of millions of pounds a year in timber prevented at a cost of from two to four cents an acre.

of foreign experiments to us, therefore, lies in the light they throw upon the possibility of doing anything to meet the danger threatened to the world at large by the steady diminution of its stock of timber trees. A brief consideration of the limits of the question shows that there are only two practicable ways in which the situation can be met: either by carefully husbanding our existing supply of timber or by replacing the trees that we are compelled to cut down. I therefore proceed to deal with

CONSERVATION AND REFORESTATION.

Hitherto I have treated the problems incidental to Deforestation in perfectly general terms, and I have not attempted to suggest any direct application of fact or principle to our own country. At this point, however, it seems convenient to digress for the moment on a topic that bears a very direct relation to the needs and prospects of New Zealand and its people. In laying down general principles about Deforestation it will, of course, be necessary to make allowance for the peculiar character of our timber industry, and the circumstances that differentiate our position from that of all other countries as regards the nature of our indigenous trees. The special feature to which I am now referring is the exceedingly slow growth of our native timber. Mr. Kirk, in his "Forest Flora of New Zealand," and Mr. W. Blair, in his "Building Materials of Otago," have given good reasons for believing that the ages of our forest trees at maturity range from 100 to 3000 years. The kauri has been cut at anything from 600 to 3600 years; the rimu takes 400 to 650 years to reach perfection, the kahikatea 370 to 600 years, the matai 270 to 400 years; even the manuka does not develop fully till it is from 100 to 250 years old. No serious objection has ever been urged against these estimates, and they answer once for all the question as to whether it is profitable or advisable to attempt

to plant native trees. But while afforestation with indigenous timber is thus out of the question, we may still ask, even thus late in the day, whether it is possible to do something here in the way of applying to our own case the results of the experience gained by other countries that, like ourselves, have drawn with reckless haste upon their splendid natural heritage of forest trees.

THE MENACE OF FIRE.

Considering the immense value of good timber, and the prospect of a rapid rise in its market price throughout the world, it would naturally seem that it would be a wise course for the State to check the indiscriminate cutting out of the native bush, and to reserve a fair proportion of this indispensable necessary for the evil days to come. And here, so far as New Zealand is concerned, we are met at once with a difficulty. In the opinion of a great many people who have had much to do with timber, it is impracticable to protect standing bush against the ravages of fire. Thus the Hon. E. Mitchelson, giving evidence before the Timber Commission in Auckland recently, gave it as his opinion that it would be quite impossible to preserve kauri bush unless it were surrounded by a very large area of mixed bush, because of its inflammable nature; and Mr. H. P. Kavanagh, chief timber expert for Auckland district, also told the Commission that it is impossible to save kauri bush, owing to its susceptibility to fire. Now, admitting the wide experience of these gentlemen, I would like to point out that the same opinion has been often advanced in other countries as to the impossibility of saving standing bush, and it has frequently been disproved by practical experiment. Let us take the case of

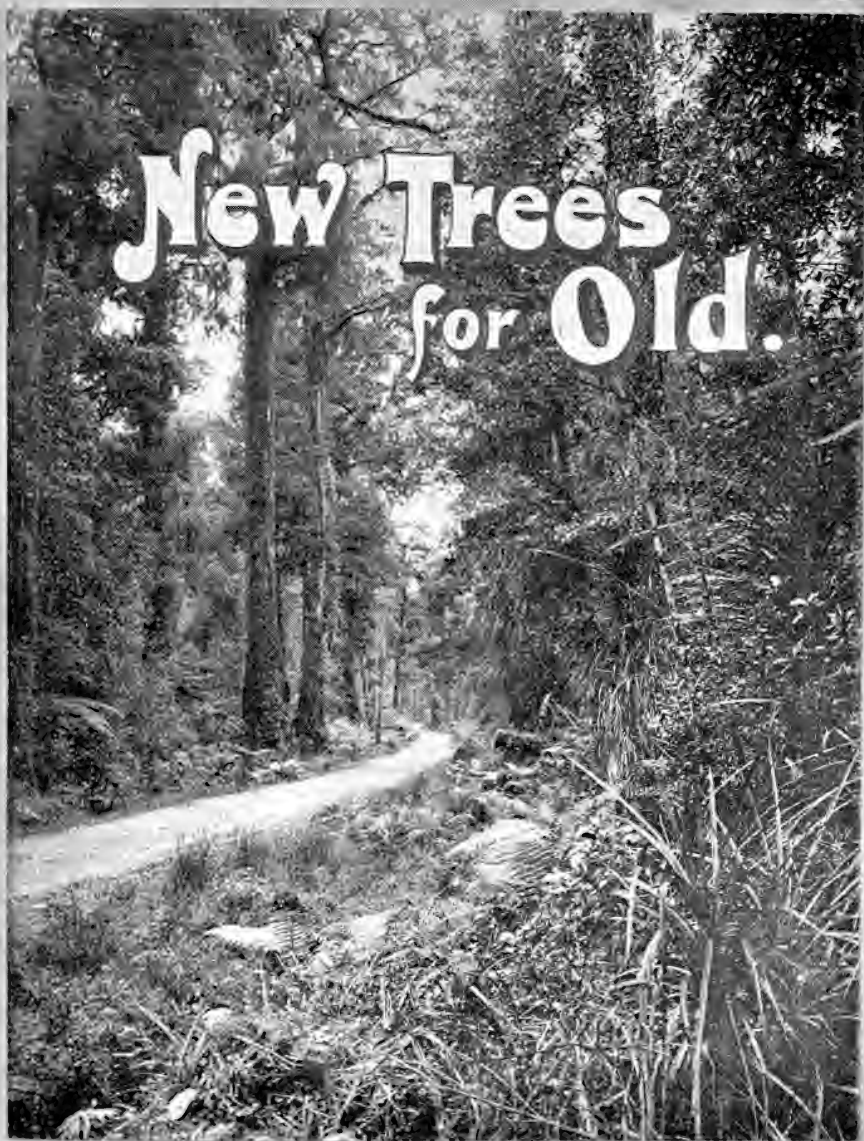
FIRE-FIGHTING IN AMERICA.

where the enormous extent of the forests and the roughness of the ground inside the timber belts would seem to render fire-saving an impossible task. Yet as the result of careful precautions and the

regular employment of a large staff of men, whose special duty it is to watch for and extinguish forest fires, the losses from fire inside the national forest reserves—covering an area of 160,000,000 acres—have been reduced to a remarkably small figure. Thus in 1906 it was officially reported that less than one-eighth of the national forests had been burned over, and that three one-hundredths of 1 per cent—about one three-thousandth part—had been destroyed. The total loss was less than £20,000; yet it is calculated that the United States have been losing on an average about £10,000,000 a year in marketable timber for a long time past through fire alone. And the remarkable results recorded inside the national forest area have been secured without any extraordinary outlay. Each one of the forest rangers engaged on fire duty has an area of over 200 square miles in his charge; and it is worth noting that in Prussia an area of 200 square miles is protected by no less than 120 foresters. Yet in spite of the enormous difficulties that have to be faced in combating fires, the forest rangers make a splendid success of their arduous task. One forest fire in Oregon, described by Mr F. J. Dyer in a recent issue of the "World's Work" (American

edition), covered an area 40 miles in circumference, and when it was first located its front was 15 miles long. The scene of operations, we are told, was 16 miles from water and 50 miles from a base of supplies, and it took 200 men nine days of ceaseless effort to put it out. But though the total cost was only £1200 in labour, it meant a saving of millions of dollars in timber. The expenditure, in fact, bears no appreciable relation to the value of the work done. Returns furnished by the American Department of Agriculture show that the southern forests can be patrolled effectively against fire for two cents an acre per year; the northern forests for not more than four cents, and those of the Rocky Mountains and of the Pacific Coast for 1½ cents an acre per year. Considering the value of the property thus protected, and the large proportion of it that would otherwise be annually destroyed by fire, the expense of fire-fighting is absolutely trivial. And it is not unreasonable to infer that the work done so cheaply under such difficult conditions and over so vast an area in America could be performed quite as effectively and as cheaply in New Zealand if a systematic attempt were made to apply the same methods here.

New Trees for Old.





HOW THE GERMANS PLANT WASTE LAND.

A splendid growth on a barren rocky slope. The timber is worth hundreds of pounds per acre.



GERMAN FORESTRY—ON THE ROAD TO THE MILLS.

The trees have been skidded down the slopes towards the mills in the valley.

V.

NEW TREES FOR OLD.

BUT while we have done nothing in the way of coping with fire by systematic means, we have done just as little in the way of making the best and the most of our natural timber resources in other ways. For Forest Conservation, as the secretary of the Kauri Timber Company recently reminded the Timber Commission, means a great deal more than protecting standing trees. To the expert in forestry, conservation means tending the forest, planting new trees to replace the old ones, cutting out only the trees ready for immediate use, and generally making the very best of our natural resources. And I leave it to anyone and everyone in the least degree conversant with the methods of timber cutting generally pursued in this country to decide whether they can be termed careful and economical. So far back as 1870, Sir James (then Doctor) Hector, addressing a Select Committee on Colonial Industries, said that the complete destruction of our native bush was most wasteful and unnecessary. "It is not all necessary," said this eminent scientist, "that the forest should be completely removed in the way that it usually is, either for the purposes of agricultural settlement, or the obtaining of timber for mills, firewood, and fencing. The thinning out of the forest would be ample in most cases to supply all our wants." No doubt our system of deforestation is just as extravagant as it was forty years ago in New Zealand; and so far as the rest of the world is concerned there seems to be a general consensus of opinion that careful and scientific methods of timber cutting would make a vast difference to the present position, and the future prospects of the industry. Rudolf Cronau, an authority who has had wide experience of American forests during the past thirty years, tells us in an

article on "A Continent Despoiled," in a recent issue of "McClure's Magazine," that the lumbermen waste half of every tree they cut. "One-fourth of the standing timber is left or otherwise lost in logging. The loss in the mill is from one-third to two-thirds of the timber sawed. The loss in the mill product through seasoning and fitting for use is from one-seventh to one-fourth. Only 320 feet of timber are used for each thousand feet that stood in the forest." This estimate corresponds closely enough with the opinion advanced by Dr. Bristol, of the United States Forestry Department, who states that at least fifty per cent, if not more, of the average tree as it stands in the forest is wasted before reaching the market in the form of timber. In similar terms Mr M. G. Seckendorf, writing on "The Elimination of Waste" in "Munsey's Magazine," has shown that some seventy-five per cent of America's forest products is wasted, and that most of this disastrous loss is due to preventable fires, careless logging, and wasteful mill operations.

THE WASTE OF TIMBER.

In view of these facts, it is not surprising to find that in the countries where some practical attempt is being made to avert the coming timber famine careful regulations are laid down for the cutting out of the State forests. In the American national forests, for example, it is stipulated that all trees cut down must be felled in such a manner as to protect the young growth as far as possible from injury, and that wherever necessary the brush and tops must be piled and burned. But merely to cut down the best trees in the best way and to save the residue from fire is not enough. Mr Julian Helburn, writing in the "American Magazine" on deforestation under the

title, "Reaping where we have not sown," emphasises the difference between the old extravagant way of cutting down forests and the modern method of treatment as laid down by the most experienced authorities on the subject. "The chief difference between the old style lumberman and the forester is that the one regards the forest as a speculation, the other as an investment. The old method is to fell all the big sound trees of a desirable species in a forest without regard to their surroundings; withdrawing the necessary shelter from a crop of seedlings in one place, killing others in the fall and removal of the timber; here felling all the seed trees so that there will be no reproduction, there clearing the way for a worthless species that will promptly choke out the valuable ones; cutting the best sections from the fallen timber and leaving the tops and boughs and parts of the trunks to dry and rot and clutter the forest floor with highly inflammable rubbish. Old style lumbering started in incontinently with the axe. Conservative lumbering begins with a working plan, which is a compromise between the forest and the market. For every tract of lumber the nature and habits of the forest and the distance and requirements of the markets present a new problem; the forester must devise and follow a fresh policy that will combine the largest returns and smallest expenses with the greatest productiveness of his forest." It is obvious that some portion of this criticism fails to apply in the case of forests like our own, where, as we have seen, the natural rate of reproduction is inordinately slow. But the facts I have cited should help us to appreciate the possibility of cutting out timber with the minimum of risk and injury to the surviving trees. But valuable as the results of conservation on these lines may be, they do not represent any attempt to increase our existing supply of timber; and for an adequate remedy for the growing scarcity and dearth of timber the world must look to some system of replacing old trees as they are destroyed or of planting new forests that will

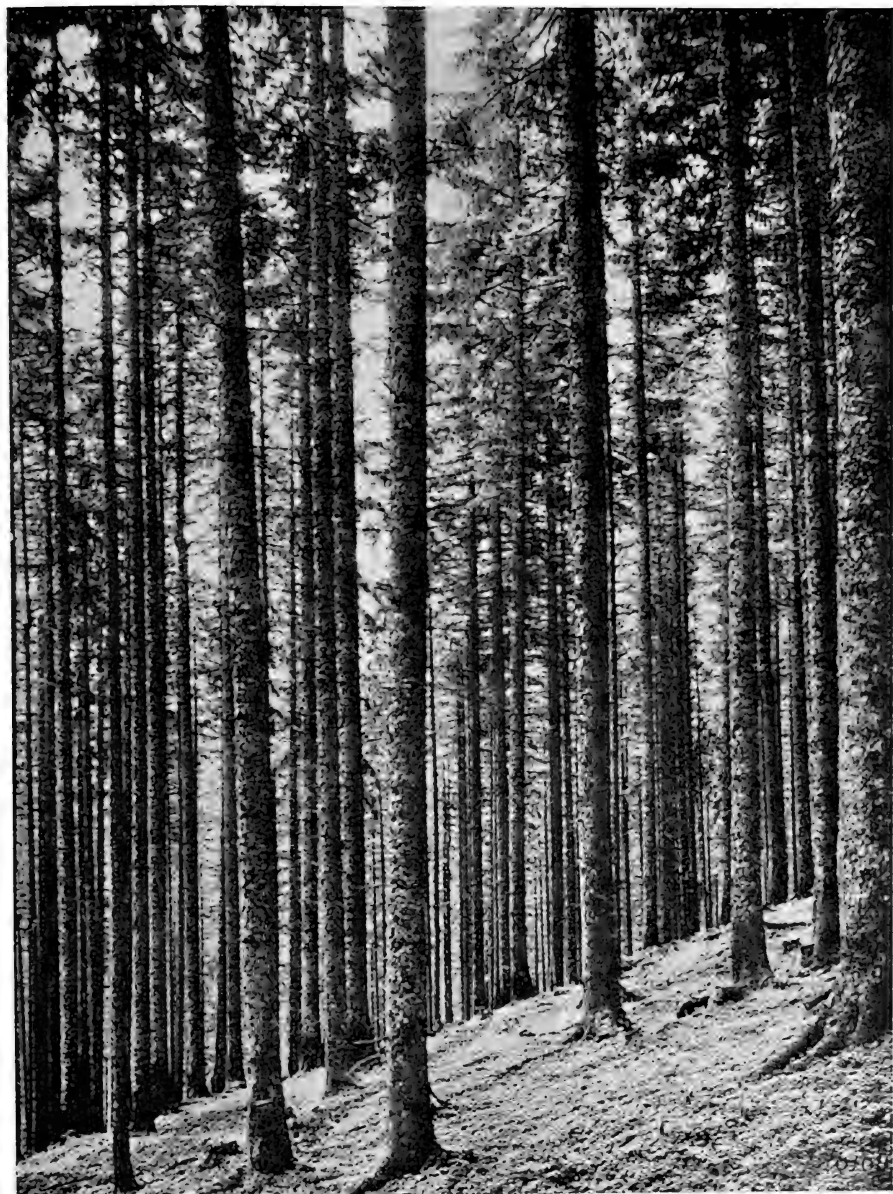
some day take the place of the indigenous bush. Thus we pass naturally from Conservation to the most important topic we have still to consider.

REFORESTATION AND AFFORESTATION.

The idea of planting new forests to replace the old ones as they are cut down is by no means a latter-day novelty. Switzerland had something like a forest system a thousand years ago, and by the fifteenth century she had developed highly practical and scientific methods of forestry. France, Germany and Italy have grown State forests for centuries past, either to check the devastating effects of erosion or to replenish a failing timber supply, or, while combining these purposes, to secure a revenue from an investment of a portion of the national capital. And these countries have succeeded in their experiments with great and permanent financial gain to themselves, for the reason that a forest properly administered on scientific lines is much more productive and valuable than a wild forest. "A large proportion of the trees in a wild forest," says Mr. A. W. Page, "are not best suited to our use. They are of the wrong species, like weeds in a garden, or they are too old or crooked, and have a variety of other blemishes; and while doing but little good themselves, they prevent the growth of better timber." It is therefore open to us either to work through the original growth rapidly, and then plant a new forest on the devastated area—a course which has been followed on a large scale in Germany; or to turn the wild forests into cultivated timber preserves, as has been largely the practice in France. I now propose briefly to refer to the success that has attended the efforts of government in other countries to establish State forests, the means they have taken to ensure their success, and the outcome of their enterprise regarded as a financial investment.

FORESTS OF EUROPE.

It may throw some light upon the importance attached to the possession



WHAT MAY BE DONE BY CONSERVATION.

A cultivated forest in Austria, after many years of scientific cutting.



THE PROFITS OF AFFORESTATION.

A forest in France that has yielded good timber and high interest for centuries, and has constantly improved in quality.

of forests by European States to remind my readers that with the exception of England, nearly all the great nations have carefully retained large areas in which the timber cut out has been replaced by natural growth or by other trees planted to fill the empty space. Thus we find that in 1902 Russia had still 516,000,000 acres in forest, Sweden 48,000,000 acres, Germany 34,000,000 acres, France and Austria 24,000,000 acres each, Hungary 22,000,000 acres, Norway 17,000,000 acres. It must be remembered that most of these countries have long since passed the stage at which the domestic supply of timber has ceased to satisfy the demand; for as we have already pointed out, France and Germany are large importers of foreign timber. Between 1830 and 1880 timber prices in Germany rose as much as 300 per cent.; and in Norway and Sweden during the last half century they have risen about 200 per cent. It is clear that if the object of these States were merely temporary and immediate gain they could secure enormous profits by cutting out their forests at the utmost possible speed. But a wise and enlightened self-interest urges them to preserve and enlarge these invaluable natural resources instead of destroying them; and so we find that Austria keeps as much as 32 per cent. of her territorial area under forest, France has 17 per cent. of her area in forest, and Germany, though a heavy importer of timber for industrial purposes, maintains forests that actually cover 26 per cent of her total area.

The methods adopted by various countries for the preservation or reproduction of their timber supplies naturally vary in detail. But it may be safely said that the forestry system adopted in Germany can be taken as a type of all the most advanced and progressive systems in practice to-day. I do not wish to trouble my readers with technical details, but it will help them to understand the scope of the subject if I describe at some length the system of

afforestation practised in Germany, and the method of cutting out the mature trees employed both in the conserved and the reforested areas.

GERMAN FORESTRY.

The work of forest-making employs a large amount of capital and labour every year in Germany, and it is carried out on thoroughly scientific lines. Seedlings are raised in carefully sheltered spots, and when the shoots are three or four inches high, they are transplanted to more spacious beds where they grow for three or four years. They are now ready to fill the gaps in the forests where the large timber has been cut away. Of course a great deal is left to natural reproduction which, in a well-tended forest may supply as much as 85 per cent of the required new growth. "Under favourable circumstances," we are told. "Nature needs little assistance, for a seed forest will practically replant itself if care be taken to keep it free from noxious weeds and other enemies, and judicious reproduction cuttings be employed." But whatever means are used to fill up the vacancies, every effort is directed toward having a well-developed second growth when the veterans are cut down. Even when the young trees have been transplanted to the chosen spot, they need constant care and attention, especially if the locality is not particularly favourable to their growth. On the Continent the most unpromising land is frequently compelled in this way to yield a large return. "Land which in America would be useless waste," writes Mr. Karl Geiser, in an article on "Forestry Results in Germany," "here supports a grove worth thousands of dollars per acre. The same thrift which plants the hanging vineyards along the steep banks of the Rhine, clothes the rocky slopes of the Black Forest mountains with perpetual green."

SCIENTIFIC CUTTING.

The same methodical care that is displayed in the cultivation of the seedlings and the replanting of waste spaces is exercised in cutting out these forests. "In

removing mature trees," says Mr K. Geiser, "the so-called 'strip system' is usually applied. This consists in cutting long, narrow openings of perhaps a hundred yards in width, extending from the main waggon road and at right angles to it, on up to the crest of the hill; and as the roads are always parallel to the streams and mountainous ridges, the strips are also at right angles to the prevailing winds, which sweep up and down the valley. The forest is thus protected from destructive cyclones, and re-production readily follows from the trees on both sides of the narrow openings. Another advantage of this method of cutting lies in the fact that the trees, when cut, may easily be skidded down the slopes to the road; from thence they are transported to the sawmills in the valley below." And when the trees are finally removed the clearing is refilled from the nursery, and the new growth, sheltered by the surrounding timber, is tended with the same assiduous care as before. Of course, from time to time the trees are thinned out. With increasing height and girth each tree requires a larger and larger space. At the first thinning the trees are left about five feet apart; 20 years later they are thinned out again to an average of eight or nine feet apart; and finally the smaller trees are cleared away again till the survivors have up to 18ft. standing room on every side. As to the determination of the time and extent of the cutting operations,

one of the central ideas of scientific forestry is that "the average yearly cut in an entire forest district shall be equal to the average yearly growth." The precise extent of the clearing and cutting operations is fixed by a forest survey, which is taken every ten years. During the succeeding years only the amount added during the previous period may be removed, one-tenth of this amount being cut every year. The advantage of limiting the consumption and organising the supply of timber in this way should be sufficiently obvious. "It preserves to the State and the community a perpetual forest; it furnishes constant employment to a large and definite number of people; every phase of forestry becomes a science; and every individual, from the chief official to the common woodman, becomes an expert since his employment becomes a life occupation. It would indeed be difficult," adds Mr Geiser, "to find a better example of industrial economy than is here exhibited. Destructive lumbering is unknown, and the enemies—such as forest fires, over-grazing and thieves—which play havoc in the American forests, are carefully guarded against by a watchful and efficient body of officials. There is system from beginning to end, and that system has long since been reduced to a science, which is being constantly perfected by the co-operation of the forestry schools throughout the Empire."

The Resurrection
of the Bush



VI.

THE RESURRECTION OF THE BUSH.

I HAVE dwelt on the German forestry system in some detail, partly because of the general interest of the subject, but chiefly because I wish to emphasise the amount of care and trouble and expense that the most business-like and economical State in the world thinks it necessary to take about the conservation of its forests and the replenishing of its timber supply. And what I have to say next bears directly upon this aspect of the question. Knowing that the Germans pride themselves on making a commercial success of their public works, we might justifiably assume that an enterprise carried out on such a scale as to employ about a million workers directly, and three times that number indirectly, must be a highly profitable investment. And, as a matter of fact, it is so. Various estimates represent the total net return to the German Treasury from the State forests throughout the Empire at from £18,000,000 to £20,000,000 a year. These are impressive figures, but the facts have been on record for many years, for even New Zealanders to reflect upon. So far back as 1879, M. Lecoy, in a paper on "The Forest Question in New Zealand," contributed to the N.Z. Institute Transactions, pointed out that Prussia, expending £1,100,000 a year on her six million acres of State forests, drew from them between 1860 and 1870 an annual revenue of £2,100,000. During the same period, Bavaria, on an outlay of less than £500,000, drew a forest revenue of £1,261,000; and France, on an annual expenditure of £70,000, drew an income of £1,400,000, or twenty times her outlay, from her State forests. And these

high average returns have been maintained, and have even gone on increasing down to the present day. Thus the little State of Wurtemberg, from one forest of 20,000 acres, averages an annual yield of £2 per acre. Considering that the forests of Germany managed on scientific lines yield on the average 46 cubic feet of wood per acre, as against about twelve cubic feet obtainable from the average American forest there must be a wide margin for profit in a forestry system when properly conducted. As a matter of fact, the net surplus from the State forests of Germany range from about 6/- per acre in Prussia to over 22/- per acre in Saxony. The forestry record of this last-named State is in many respects so interesting that I am tempted to quote in some detail the remarks made by that eminent authority, Professor Schlich, in an article dealing with the British forestry problem. There are reliable statistical data for the State forests of Saxony since 1817. Between 1817 and 1893 their area increased by about 17 per cent. In 1817 the yield in wood per acre was 61 cubic feet; in 1893 it had risen to 92 cubic feet, an increase of about 50 per cent. Within the half-century, from 1844 to 1893, the average stock of wood standing on each acre had increased from 2,173 cubic feet to 2,658 cubic feet, that is to say by about 25 per cent. This means that the forests, in spite of the greatly increased annual yield, are now much more valuable than they were fifty years ago. As to the pecuniary return, the records are even more instructive. From 1817 to 1826 the average net revenue from the Saxony State Forests was 4/- per acre; from 1854 to

1863 it was 10/- per acre; from 1884 to 1893 it was 18/6 per acre; and by 1900 it had risen to 22/6 per acre. Taking these facts in conjunction, we see that between 1817 and 1900 the average receipts per cubic foot of wood have risen by about 114 per cent, while the net receipts per acre have risen during the same period by over 460 per cent. "Surely," as Professor Schlich remarks on concluding this analysis, "here is an incontrovertible proof of what scientific and systematic management of woodlands can achieve."

I have probably said enough to convince most people that forestry properly conducted affords an extremely lucrative form of investment either to the State or the individual, and that the successful experience of other countries fully justifies us in making experiments on similar lines here. The reason for such an undertaking is, of course, the ever-growing certainty that our timber supply is being rapidly reduced, and that we already find it unequal to the demand. And if, after we have considered the risks and perils involved in Deforestation, as already set forth in my earlier articles—the destruction of soil, the flooding of rivers, the deterioration of climate, and the reduction of the country's productive powers—if, beyond all this, some further argument is needed to strengthen the case for Afforestation, we may find it in the large pecuniary profits always secured by either States, corporations, or private individuals who have undertaken, under favourable conditions, the lucrative work of tree planting.

PRIVATE ENTERPRISE.

It may be as well to remark here that so far as the general benefit to the country is concerned, this can be secured equally well whether the trees are planted by the State or by private individuals. And as an encouragement to those persons who may feel inclined to make practical use of the experience of other countries in this matter, I may point out that by far the best financial results

that have been secured from tree planting in England and America are due more or less to private initiative. In Perthshire not long since, a plantation of Douglas fir just forty years old, was valued at £200 an acre to the enterprising grower. But forty years is a long time to wait, and pecuniary results can be secured by judicious management in a much shorter period than this. In Kansas, we are told by Mr. T. H. Will, secretary of the American Forestry Association, a catalpa plantation, 10 years old, has been valued at £40 per acre; another in Nebraska, 14 years old, gave a net return of £37 per acre; another also in Nebraska, 16 years old, gave a net return of £31 per acre. Cedar plantations, twenty-five years old, produced £40 per acre in the United States, and European larch, of the same age, is worth from £40 to £60 an acre. A mixed plantation, started by a director of one of the Western railways in Kansas on two square miles of waste land, after 25 years' growth, yielded more than £25,000 worth of timber to the company in one year. Another plantation, owned by another railroad company, has been described by Professor Gifford, of Cornell University. Within twenty-five years this area of 400 acres could show a clear net profit of £28 per acre, and a gross value of nearly £79 an acre. These figures should be sufficient to impress the ordinary commercial imagination deeply enough. If any of my readers would prefer an illustration taken from nearer home, I may quote an interesting case from Australia. Near Creswick, in Victoria, there is some wretchedly poor land, which has been planted with several varieties of pine. "The particular hillside chosen," we are told, "is lightly covered with a lifeless clay soil, often so scanty as to lay bare the sandstone. The natural vegetation was of the most meagre and valueless kind. In the early days miners riddled the area for gold, and when the officers of the Government took charge it was a hillocky waste." About 700 acres of this very unpromising



A RAILWAY PLANTATION LESS THAN TWENTY YEARS OLD.

American railroads now endeavour to supply their own timber, and all over the United States the companies are planting largely for sleepers and bridges.

land were planted at a cost of about £2 per acre, and the expense of looking after the plantation has been very small. Today, after 17 years of growth, the timber is being sold at prices that yield from £100 to £200 per acre net profit.

WHY NOT HERE AND NOW?

If all this can be done in Germany and America and Australia, there is certainly no reason why it cannot be done in New Zealand. And, as a matter of fact, practical experience in this country has already shown that tree-planting can be made a highly profitable venture within a relatively short space of time. In our official forestry handbook, "Tree Culture in New Zealand," the late Mr. H. J. Matthews cites the case of a larch plantation started in Canterbury in 1887 on poor, dry soil. The land was worth £2 an acre, and the total cost of trees, fencing, and plantation was £12 an acre. Very little attention was given to the trees during their growth, and £1 per acre would more than cover this form of expenditure. The total cost to the proprietor was, therefore, £15 per acre. After 17 years' growth, the total value of the timber in the plantation was estimated by Mr. Matthews at £270 per acre. "Deducting the initial cost of £12, there remains a credit balance of £258 as a return for 17 years' growth, and the land is in better condition now (through the humus formed by the annual fall of leaves) than it was at the start." By way of contrast, Mr. Matthews notes that portions of the adjoining land are let for grazing at 2/ per acre a year—that is, 34/ in 17 years. "No other crop," says Mr. Matthews, "whether grain-growing, mixed farming, stock raising, fruit or vegetable growing, can compare with the above results, while at the same time not only has the soil been retained in a fertile condition, but it has been vastly improved in its productive capabilities."

Taking all this into account, we may reasonably infer that in this country,

endowed as it is with a mild and equable climate and a bountiful rainfall, even the waste land that will not grow anything else might be turned to highly profitable use by tree-planting. There is an immense amount of land of varying character in these two islands, from the rocky slopes of the Southern Alps and the gravel flats of the Canterbury plains to the pumice lands of the centre and the gum lands of the northern half of this island, that could certainly be utilised for afforestation purposes without interfering with the progress of settlement or encroaching upon the areas required for our other staple industries. Even to private enterprise, the pecuniary prospects offered here by afforestation should be alluring enough; and as we have seen, no long time need be expected to elapse before the returns begin to come in. As a final word of encouragement to the settler or the farmer hesitating whether to plant trees or not, I may quote from "Tree Culture in New Zealand" again:—"To most farmers the raising of a crop of trees from seed or from seedling-trees seems a long and hopeless undertaking. The period required for a tree to attain profitable size under favourable conditions is, however, much shorter than is generally supposed. In from 10 to 15 years from the time of planting, all the fuel and fencing material necessary for farm use can be had for the cutting, without in any way interfering with, but, on the contrary, being an actual benefit to, the remaining trees."

THE DUTY OF THE STATE.

But it must now be sufficiently obvious that from the national point of view, the work of Reforestation, or Afforestation, is of such vast and far-reaching importance that it ought not to be left to private enterprise alone. As Professor Schlich has recently pointed out in a letter to the "Times," dealing with the report of the British Afforestation Commission, "practical policies clearly indicate that the State, corporations, and private proprietors, must co-

operate in the scheme of afforestation." But as we have seen in the case of Germany, there is a great deal to be gained by working afforestation on a comprehensive and systematic plan that shall be perfectly consistent and continuous over a long period of time; and it is clearly impossible to secure these advantages in the highest attainable degree, unless the work is taken up by the State. So far as corporations are concerned, the commercial bodies best fitted to undertake afforestation are railway companies. "Railroads," says Mr. J. Gifford, of Cornell University, in an article on "The Railroads and Forestry," "as a matter of fact can produce timber to better advantage than any other proprietor"; and the reasons he gives are that railroad companies are long-lived, they must have timber for ties, and sleepers, and bridges, and they can transport it at a minimum cost. The reduction of the future cost of maintenance is to such corporations, as Mr. Gifford says, simply a business proposition, and he quotes a large amount of evidence to show that in America they have made a great success of it. In a country like our own, where the railroads are in the hands of the State, the arguments in favour of afforestation by corporate enterprise apply with equal force to the assumption of this public duty by Government itself. As to action by private individuals, a great deal has, of course, been done by rich land owners in England and America to repair the ravages in the native forests, and to restock their estates with timber. Even in New Zealand, young and relatively poor as the country is, reforestation and afforestation have been carried out more or less tentatively and experimentally by a large number of our settlers and station holders. The work done in this respect by Mr. J. Hall, at Parawai (chiefly experiments on the growth of indigenous trees), by Mr. R. Reynolds, at Cambridge, and by Mr. T. Adams at Greendale, Canterbury, deserves public recognition, not to say

public gratitude. Those of my readers who have had occasion to refer to our Government publications bearing on the land, and its products must be familiar with the reports of Mr. Adams upon the growth of imported trees, which form a permanent feature of the Official Year Book of the Dominion. But such experimental work, valuable as it undoubtedly has proved itself to be, lacks the essential requisites of comprehensiveness and continuity; and apart from all other considerations, the heavy expense and the long period of waiting involved, render it impossible that any systematic scheme of afforestation or reforestation could be undertaken in New Zealand by private enterprise alone. In this country, where we have extended the functions of Government with such beneficial results to so many forms of public work and duty, we may fairly throw the chief responsibility for the replanting of our forests and the replenishing of our timber supply upon the State.

WHAT NEW ZEALAND HAS DONE.

I may say here that I do not suppose that many people whose attention has not been specially called to the facts of the case, have any idea of the amount of work already done in this direction in New Zealand by our various Governments. As Mr. Kensington, the Under-Secretary for Lands, pointed out recently in his evidence before the Timber Commission, reforestation, as the work of a State department, has been in existence in this country only about ten years. During this period, the whole of the outlay—some £170,000 in all—has been drawn from the receipts from the State Forests. Not a single penny has yet been voted by Government for the special purpose of reforestation. But, in spite of the inadequate financial basis on which our Forestry Department is founded, much valuable work has been done. About 63,500,000 trees and seedlings have been planted, of which over 6,000,



OUR AFFORESTATION WORK — EUCALYPTUS REGNANS, EIGHT YEARS OLD, 60ft. HIGH.

One of the Australian gums on which experiments are being made.

000 were added to our stock last year. The New Zealand State Forests Act passed in 1885 set aside large areas of Crown lands as State forests, and provided for the establishment of schools of forestry. But it was realised that something must be done to counteract the constant drain on our timber resources, and since the late Mr. H. J. Matthews was appointed in 1896 to supervise the reforestation work, considerable progress in this direction has been made. The Commissioners of Crown Lands act as Conservators of the State forests, and under them are the Crown Lands rangers and timber experts, who help to inspect the forests and take precautions against their destruction. Apart from forest conservation, reforestation and afforestation are provided for by the establishment of nurseries—at Eweburn and Tapanui (Otago), at Hanmer (Canterbury), at Starborough (Marl-

borough), at Ruatangata and Rotorua (Auckland). As I have said, millions of trees have been sown and planted in these localities, and care has been taken to select those varieties which will not only give the best returns when they reach maturity, but will grow most rapidly under the climatic conditions that obtain here. But though I am far from desiring to depreciate the good work done by our late Chief Forester, and by the Lands Department in their attempt to replace our rapidly disappearing native bush, the fact remains that the total area so far replanted is only a little over 12,000 acres, and this manifestly represents a miserably inadequate provision for the needs of this country in the distant future, and an entirely ineffective defence against the many evils which, as I have already shown, deforestation always brings in its train.

THE REVENGE OF THE BUSH.





HOW OUR SETTLERS' HOMESTEADS ARE SACRIFICED THROUGH THE RECKLESS DESTRUCTION OF THE BUSH.

This house, when erected, was quite 100 yards away from the river bank. In the previous flood, the last 20 feet of the bank were carried away.

VII.

THE REVENGE OF THE BUSH.

FOR fuller details as to our State nurseries and plantations I must refer my readers to the many valuable and interesting reports issued by the Lands Department, and to other official publications of the same type. But the general impression I wish to convey must be by this time sufficiently clear that, while the work done by the State in this direction is good as far as it goes, there is not enough of it to meet the requirements of our situation. I have intentionally refrained from entering at length into the technical details of afforestation, but I may remark here that there are certain points in the official reports that encourage comment even from one who can make no claim to be regarded as a forestry expert. For example, there is the important and highly debatable question of the choice of trees best fitted for planting in different localities. It seems to me that many ordinary people reading the reports upon the large numbers of trees that have been experimented with and proved a failure because of frosts, winds or other unfavourable conditions, would be inclined to regard tree-planting, especially by private enterprise, as rather a hopeless task. Even the extremely valuable papers published by Mr T. Adams, of Greendale, upon his experiments with varieties of eucalyptus and many European trees produce a rather misleading effect through their constant reference to the injurious effects of frost and cold winds. It seems to me highly desirable to emphasise the fact that many valuable varieties of the eucalyptus and many important European timber trees can be grown in most parts of this country without the least risk of injury or loss from climatic causes. And I may add that it seems to me a most serious

disadvantage to the North Island, which possesses large areas of waste land, well suited for afforestation, that the majority of the important experiments in tree-planting officially placed on record have been made either in the South Island or in the elevated and inclement region of Rotorua. Results thus obtained, I may suggest, cannot safely be applied to localities in which the climatic conditions are of an entirely different character.

THE REMEDY.

The only remedy is, of course, for the Lands Department to extend its operations over a large number of districts differing as far as possible in their local characteristics. And it is manifestly desirable that the Department should circulate as widely as possible the most accurate information obtainable about the right method of growing approved timber trees, and the best way of dealing with them when they come to maturity. I may illustrate the importance of this last suggestion by one or two detailed references. Take the eucalypti, and for special instance, the blue gum. Even in Australia, as the Melbourne "Age" has recently pointed out, the value of the blue gum is constantly depreciated and underestimated, because it is cut at the wrong season of the year. The eucalypti generally speaking are rapid growers, so prolific that in many cases they secure their own reproduction by heavy seeding; they furnish a great variety of valuable timbers; and many of the most important species acclimatise readily here. But if, when ready for use, they are cut at the wrong time of the year, and are utilised at once without proper seasoning, the results are

naturally disappointing. Another illustration of the risk of inadequate experiment and insufficient information is the case of the much discussed Catalpa tree. This tree (*speciosa* variety), in America, has produced almost fabulous results, as its timber is extremely durable, and reaches maturity in from ten to fifteen years. But whether because the right variety has not been secured, or the conditions of soil and climate have not been judiciously selected, the results so far have been, on the whole, distinctly discouraging. Yet, even as it is, we learn from the departmental hand-book on "Tree-Planting in New Zealand" that the Catalpa can be grown successfully in most parts of New Zealand, where the soil is moderately fertile, free, and open, the situation sheltered, the rainfall not less than 30 inches per annum, and where the thermometer does not fall below 20 deg. Fahr. A great many districts in New Zealand fulfil these conditions, and considering that the timber produced by the tree is almost indestructible, and the tree comes to maturity at so early an age, it is highly advisable that experiments with it should be extended and that the results should be recorded and circulated as lavishly as possible. And all this, I need hardly say, can be done far less effectively and easily by the individual than by the State.

But I will have written to very little purpose if I have not long ago convinced my readers that the work of Afforestation and Reforestation is not only a responsibility that can most easily be assumed by the State, but is at the same time a public duty of the most urgent and importunate character. In the later sections of this series of articles I have dwelt at length upon the directly material losses entailed by the destruction of the world's forests, and the dangers involved in the rapidly approaching and practically inevitable timber-famine. My own conviction is that in the long run the worst of those

Evils of Deforestation with which these articles have dealt are the injuries inflicted upon a country's climate and soil and productive powers through the indiscriminate cutting out of native bush and the failure to replace it, and to combat such evils is the manifest duty of the State. But perhaps the simplest way of enforcing my arguments, as they have now reached a natural close, is to recapitulate them briefly. It is an artificial method, I am well aware, but it may be none the less effective for that.

THE VENGEANCE OF TANE.

In the first place, then, let us briefly reconsider the value of trees from the standpoint of the climate and the productivity of New Zealand. According to Professor Schlich, forests produce the following effects:—They reduce extremes of temperature by increasing the humidity of the air, and thus tend to increase the rainfall; they help to regulate the water supply by ensuring the steady feeding of springs, and thus they tend to reduce the volume of floods; they help to prevent landslips, and the silting up of rivers, and they arrest moving sand; they afford shelter to vegetation from strong winds; and by aiding the generation of oxygen and ozone, they tend to improve the hygienic conditions of life. From these considerations it is easy to infer the nature and the extent of the harm done to a country by the destruction of its indigenous forests. To describe briefly the character of these injuries, let me quote from a distinguished American authority, Professor Trotter:—"When the forests are cut down, delicate adjustments in the balance of Nature are destroyed. The soil is exposed to the disintegrating effects of the atmosphere. In summer it is baked to dryness; in winter it rapidly loses heat by radiation. In colder regions the loosening effects of frost are readily seen in an exposed soil. In a region denuded of trees the supply of springs becomes intermittent, no longer



WANGANUI SUBMERGED.

As the streets were impassable for foot traffic, carts made a very profitable business of taking passengers across the roads at 6d. per head.



FLOODED OUT AT FOXTON.

Another illustration of the ravages of a river which, solely through the destruction of the bush on its banks, has become liable to regularly recurring and devastating floods.



THIS CLIFF ON THE MANAWATU, QUITE 100 FEET HIGH, ORIGINALLY EXTENDED—AS SHOWN BY THE DOTTED LINE—to WHAT IS NOW THE CENTRE OF THE RIVER BED.

The end of the fence on the hill shows where the road, which was constructed only a few years ago, has been cut away. All attempts to protect the cliff against the river have failed.

fed from the constant and unfailing reservoirs of the forest soil. The heavy dash of rains washes away the loose earth, carrying it into the streams, which become turbid torrents. In the spring, when the ground is still hard from frosts, the rainfall and the rapidly melting snow run off the slopes, leaving only a small part to sink into the ground. This immediately swells the brooks and tributaries of a river basin beyond their carrying capacity, causing freshets, which tear away the banks, and obstruct the channels at various points with accumulations of stone and other debris. The over-full brooks discharging into the larger tributaries raise the waters of the rivers into mighty torrents that sweep seaward, often causing disastrous floods in the lower valleys. Almost as quickly as they rise the rivers fall again, and should a prolonged period of dry weather follow, they will shrink away into their deeper channels, leaving the side shoals exposed as mud flats. The brooks become dry beds no longer fed through springs nursed by the bountiful supply of a forest region." I have already considered in some detail the disastrous effects thus produced, but the subject is so important, and in this country the dangers indicated are so real and so imminent, that I feel justified in emphasising them once more by a further quotation. Marsh, in his classical work "Man and Nature," describing the destructive effects of deforestation upon the land, says: "The soil is bared of its covering of leaves, broken and loosened by the plough, deprived of the fibrous rootlets that held it together, dried and pulverized by sun and wind, and at last exhausted by new combinations. The face of the earth is no longer a sponge but a dust heap, and the floods which the waters of the sky pour over it hurry swiftly along the slopes, carrying in suspension vast quantities of earthy particles, which increase the absorbing power and mechanical force of the current, and, augmented by the sand and gravel of falling banks, fill the

bed of the streams, divert them into new channels, and obstruct their outlets. From these causes there is a constant degradation of the uplands, and a consequent elevation of the beds of water courses and of lakes by the deposition of the mineral and vegetable matter carried down by the waters. The channels of great rivers become unnavigable, their estuaries are choked up, and harbours which once sheltered great navies are shoaled by dangerous sand bars. The washing of the soil from the mountains leaves bare ridges of sterile rock, and the rich organic mould which covered them, now swept down into the damp low grounds, promotes a luxuriance of aquatic vegetation that breeds fever and more insidious forms of mortal disease, and thus the earth is rendered no longer fit for the habitation of man."

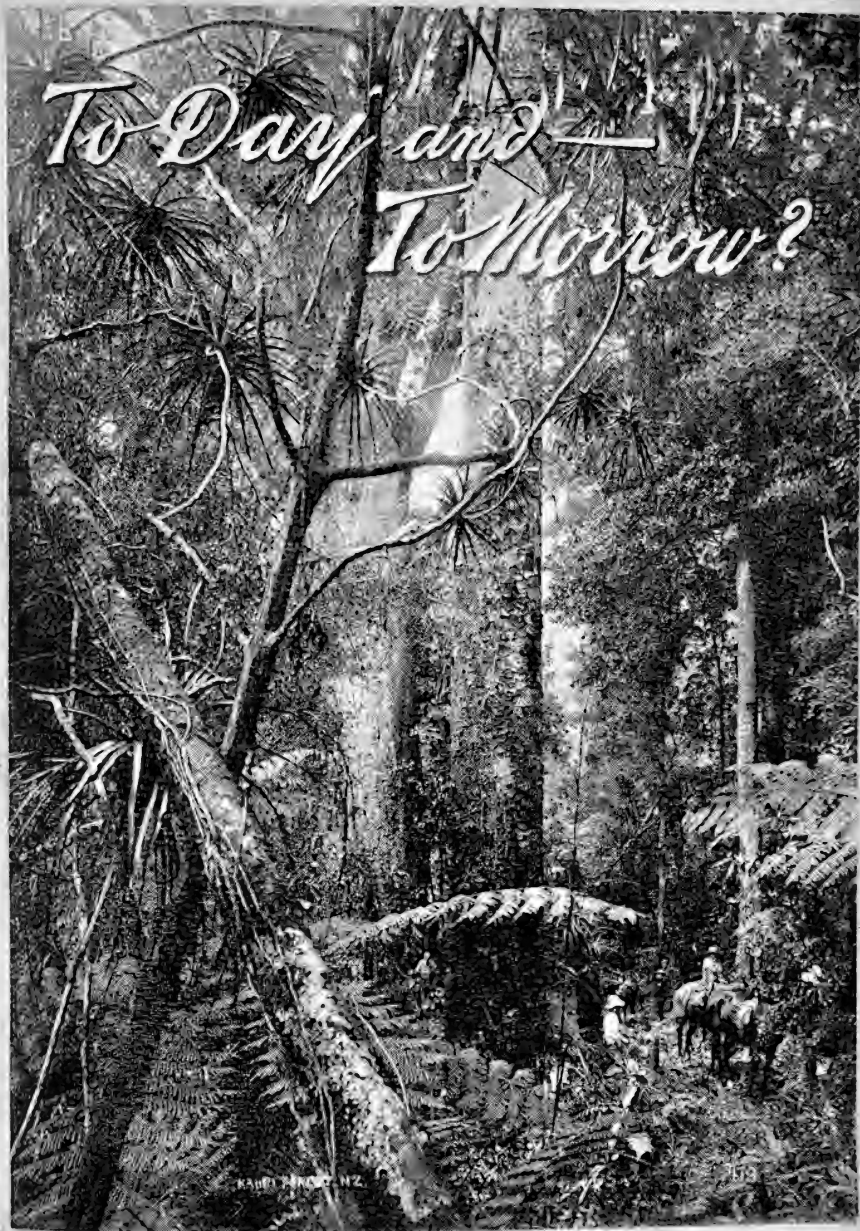
FLOODS IN NEW ZEALAND.

This is indeed a depressing picture, but I believe that it is not one whit exaggerated, either in its details or in its general effect. And to apply the argument more directly to this country, I will remind my readers of the extent to which floods have increased in recent years throughout these islands in all the districts watered by rivers flowing down from hills where the bush has been partially or wholly cleared away. This is a subject on which I have, no doubt, a large amount of valuable information could be compiled from the reports of engineers and other experts submitted to county councils and road boards from time to time in both North and South Islands. Some years ago Mr. R. W. Holmes, now engineer in chief to the Public Works Department, reported to the Feilding Borough Council on a serious washout at the junction of the Oroua and Kiwitea Rivers, involving the loss of over 50 acres of valuable land, and he attributed this disastrous flood entirely to the destruction of the bush along the upper courses of the rivers. Throughout the Wellington and Wanganui districts the same tale can be told. The Mana-

watu, the Wangaehu, the Rangitikei, the Turakina have all followed the same course with the same disastrous consequences. In the Hawke's Bay district similar conditions have produced similar results; and all over New Zealand, wherever the bush around the sources of streams has been cut away, floods of varying degrees of intensity and destructiveness have inevitably followed. Already the penalty paid for our recklessness has been a heavy one, reckoned only in the money value of land washed away or overlaid with debris, in stock drowned, and property destroyed, and in the huge and increasing outlay on

bridges that must be constantly repaired and approaches that must be continually lengthened, and groins and embankments that must be perpetually strengthened against the encroachments of these turbulent streams. Surely this constant and steadily increasing drain upon our resources calls for a little forethought and prudence on our part, and emphasises the demand that the authorities should arrange for an exhaustive investigation into the well-known and generally admitted connection between the cutting away of the bush and the increased frequency and destructiveness of floods throughout New Zealand.

*To Day and —
To Morrow?*



HAUTERMAN, N.Y.



A DEFORESTED HILLSIDE.

The rain water runs off as fast as it falls, carrying much of the soil with it.



HOW NOT TO CUT DOWN BUSH.

VIII.

TO-DAY AND TO-MORROW?

HERE is one phase of this question that I must not altogether ignore, though it will be impossible in a general sketch of this kind to treat it in full detail. I refer to the effects produced upon river and harbour navigation by the floods which result from the clearing away of the bush. New Zealand is not, of course, the only country in which this evil has manifested itself. If we turn to America we find an imposing mass of evidence already collected under this head. In an article entitled "A Continent Despoiled" Mr R. Cronau shows how at least a billion tons of soil are swept away every year from American hillsides into the rivers and harbour mouths, not only robbing the country, but depositing the silt and spoil where it does permanent and irreparable harm. "Year in, year out, our Government spends millions upon millions to dredge river channels and harbours that become clogged with gravel, snags, and mud, deposited there by the floods." In almost the same terms, Mr. M. G. Seckendorff, in an article on "The Elimination of Waste," in a recent issue of "Munsey's Magazine," drew attention to the appalling waste of money that is one of the indirect effects of soil-erosion. "The soil-matter annually carried into lower rivers and harbours," he tells us, "is computed at 780,000,000 tons. Soil-wash reduces by ten or twenty per cent the productivity of upland farms and increases channel-cutting and bar-building on the rivers. The annual loss to the farms alone is fully 500,000,000 dollars"; and he proceeds to point out that the fertile soil thus irretrievably lost to the country involves its people in still heavier loss when, accumulated in rivers and harbours, it compels them to remove it at enormous expense.

THE COST OF SILT.

And in New Zealand, as I have already indicated, needless and burdensome sacrifices are constantly entailed upon us all by similar causes producing like effects. Everybody who has lived near the mouth of any of our rivers knows what a bar is, and how seriously it impedes navigation and trade. The silting up of our bar-harbours and the blocking of river-mouths along our coasts have already cost this country untold wealth, and the evil is steadily intensifying itself with the progressive destruction of the bush. It would, indeed, be interesting to get a return of all expenditure incurred in the Wellington-Taranaki district alone in the attempt to dredge and keep open the Patea and the Wanganui and other streams. And within a short time some systematic attempt to cope with this danger will become absolutely imperative. I can hardly sum up this portion of my argument better than by quoting from an article on this subject which appeared some time ago in the Wellington "Evening Post." The writer deals first with the silting evil in general terms. "In all parts of the Wairarapa, and, indeed, throughout New Zealand, farmers and local bodies are faced with the trouble of the silting up of the river beds. Gravel and debris are brought down the streams in flood time. The lifting up of the river-beds forces the streams to deviate all over the country by their own natural law. The result is that in the progress of years a river covers an area miles in width. But this erosion process is not by any means the worst of the story; and he goes on to refer to the destructive effect of the deposition of silt at the river

mouths. "Should there be any appreciable silting up of the Ruamahanga near its mouth, the consequences will be most disastrous to the whole of the Wairarapa in flood time." And if we add to the damage thus done by banking up the flood-waters, the injury inflicted everywhere on our coastal trade by the choking of otherwise navigable rivers, we must agree that "what is wanted is a comprehensive scheme for river conservation all over New Zealand, outlined by Government engineers especially appointed for the purpose." But these articles have been written to little purpose, if I have not by this time convinced my readers that no scheme of soil protection or river conservation can be of any value which does not take into account the devastating effects of the destruction of the natural bush along the banks of our streams.

DENUDATION AND EROSION.

But the prevalence of floods and the silting up of rivers and bar-harours is not by any means the only evil effect of deforestation, of which New Zealand has already had practical experience. I have spoken earlier in these articles of the terrible consequences of erosion and denudation on hillsides where forests have been cut away; and though our country has been too recently settled and cleared to exhibit the worst effects of these changes, it is no exaggeration to say that there is not a single district in the Dominion from the Bluff to the North Cape that does not in some way illustrate my argument. Travelling recently from Wellington to Auckland by the Main Trunk line, I looked out on mile after mile of hillside where the bush had been cut out, and where great gashes and clefts and channels had already been torn by landslips or scoured by rain. Everywhere these infallible signs show that the soil, no longer kept in place by trees and brushwood, is being washed down into the valleys, and it is only a matter of time before the hills will be stripped bare and

the flats at their base will themselves be overlaid with the clay and shingle that will pour down as the process of erosion goes on. What all this may ultimately mean to the country, it is, as one of the greatest authorities on the subject has said, very difficult to convey in words. Marsh has traced in detail with impressive eloquence the transformation of "forest-crowned hills, luxuriant pasture grounds, and abundant cornfields and vineyards well watered by springs and fertilising rivulets to bald mountain ridges, rocky declivities and steep earth banks furrowed by deep ravines with beds now dry, now filled by torrents of fluid mud and gravel hurrying down to spread themselves over the plain and dooming to everlasting barrenness the once productive fields. In traversing such scenes," adds this distinguished observer, "it is difficult to resist the impression that Nature pronounced the curse of perpetual sterility and desolation upon these sublime but fearful wastes, difficult to believe that they once were, and but for the folly of man might still be, blessed with all the natural advantages which Providence has bestowed upon the most-favoured climes." This is no imaginative or fanciful description. It is absolutely realistic in its accuracy, and it depicts only too clearly the terrible fate that may overtake New Zealand, as it has overtaken many other lands, if we disregard the warnings of history and the recorded experience of the past, and recklessly destroy our forests for the sake of a little temporary gain.

A PLEA FOR CAUTION.

At this juncture I am well aware that I am likely to be met with the question: "Do you really mean that we ought never to cut down bush; and if you do mean it, what will become of the timber industry, and how is the country to be settled?" I reply that there is no reason why a rational policy of conservation should not be perfectly consistent with the maintenance of a large timber trade and with the steady progress and development of the country. The difficulty is



A VALUABLE SCENIC RESERVE AT PALMERSTON NORTH ON THE BANKS OF THE MANAWATU, IN
PROCESS OF BEING DESTROYED BY THE RIVER.

The dotted line shows area of land washed away in a single night in the last great flood.

that our bush is being cut away in places where it ought to be preserved, on land that can never be of much use for any other purpose, and that the process of deforestation everywhere is being hurried on with reckless extravagance and haste. It is easy to find a large amount of evidence in support of this statement. In an article on our "Vanishing Forests," contributed by Mr P. J. O'Regan a few months ago to the "New Zealand Times," it is pointed out that in various parts of New Zealand "hill country is being opened for settlement in complete disregard of the grave consequences that must ensue." What those results must be in the way of erosion and denudation and floods, I have already tried to explain, and these facts are fully appreciated by Mr O'Regan. He adds that in many localities "hill country has been and will be surveyed and thrown open to settlement that, as a matter of the highest public policy, should be left as it is." When Mr. O'Regan tells us that especially in clearing bush and opening up land in Nelson and Westland, "the course at present being followed is in the last degree subversive of the public interests," he is not in any sense exaggerating these evils. And his judgment is amply confirmed by official pronouncements on this question.

THE CASE OF WESTLAND.

I may quote from some remarks on the deforestation of Westland that appear in the report on State forests issued by the Lands Department for 1905-6. The writer points out that as a large part of the West Coast is very inaccessible—consisting of narrow valleys with steep, shingly hillsides—it is practically impossible to cut out the timber there at remunerative rates. "In these deep valleys and on the lands above 2000ft. in altitude, it would be a fatal mistake to allow timber to be removed. It is not the actual removal of mature trees which is to be feared, but the wholesale destruction that inevitably follows. In felling trees the tops and branches are left to rot or burn, to remove the timber tracks are necessarily opened out, and are made use of by cattle

which destroy and keep down undergrowth, the thin coating of vegetable deposit is gradually washed away, and in time nothing is left but barren hillsides, from which the rainwater pours off to swell streams and rivers with disastrous effects in the lower valleys." The report goes on to deal with the danger of floods, and their destruction of valuable soil, and after dwelling upon the reckless extermination of silver pine, and yellow pine on land that is absolutely worthless for any other purpose, it comes to the conclusion that owing to the destruction of the bush along the river banks, "irreparable damage is being done," and that "the sources of rivers and streams" should be protected against the depredations of the timber trade. It happens that Westland, from its conformation and topographical peculiarities, is especially liable to injury through the removal of the indigenous bush; and if such precautions are not taken in time, one may safely predict that the extermination of its trees will convert the whole country into a barren and desolate waste, forbidding, unproductive, and uninhabitable. But the danger is not confined to Westland alone; and in all parts of New Zealand we may find impressive indications of the injury already inflicted by the reckless extirpation of our bush. I cannot close these remarks more appropriately than by a quotation from one of the valuable reports supplied by Mr. T. E. Donne to the Tourist Department whilst it was under his control. "The forests were, and are still, destroyed unmercifully without any thought of the future. Bush was burnt down on absolutely valueless land, which was thoroughly unfit for settlement. The soil was thus deprived of the only good vegetation it could produce. Very often neither the cut bush nor the ground had any commercial value whilst the bush, if spared, would have preserved at least the eminently attractive picture of the landscape." Even if there were nothing else about our native

bush worth saving, but its incomparable beauty, it would, as Mr. Donne has elsewhere written, "be a crime against the nation" to cut it down without very solid material reasons. But when its destruction is often not only profitless, but terribly and disastrously injurious to the highest interests of the country, we may well wonder at the careless self-complacency with which we have come to tolerate these ruthless raids upon our native timber.

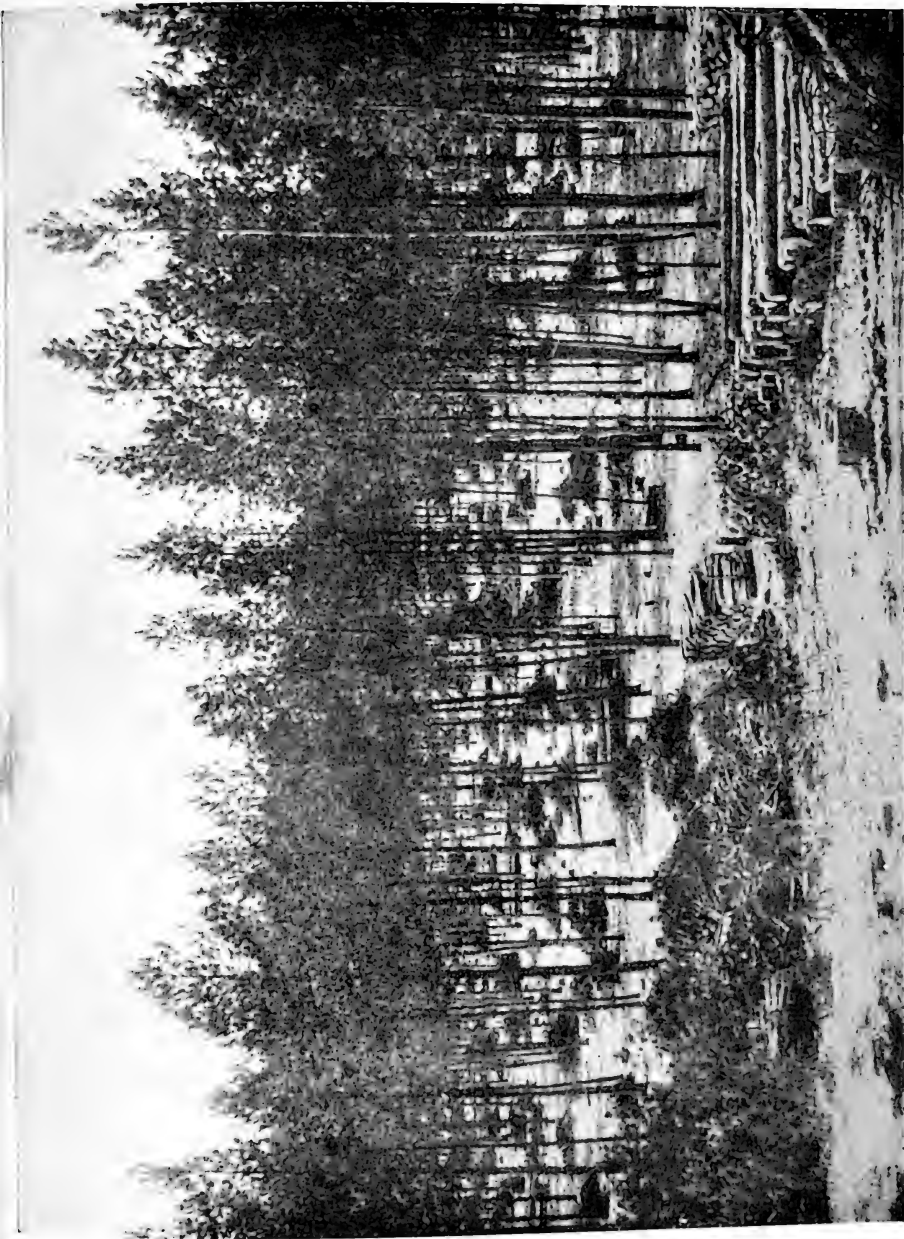
NEW ZEALAND'S TIMBER PROSPECTS.

This statement of the case might be prolonged almost indefinitely by the accumulation of further evidence. But I must be content with what has been already written, as to the direct losses and injuries sustained by this country through deforestation. And if these are not arguments of sufficient force to compel public attention and to induce Government to take in hand the conservative, the protective, and the reconstructive work of Forestry, I may appeal once more to the fact that has so far done more than anything else to arouse public interest in this momentous question—the imminent and almost inevitable timber famine. I am aware that I am now retraversing ground that I have already to some extent covered, but to apply the moral of the general argument to the special case of New Zealand it is necessary to indulge in a certain amount of recapitulation. And I am encouraged in this course by recent experiences that have taught me the difficulty of convincing even people who might be expected to realise the facts of the case, that the world's timber supply or even our own stock of indigenous timber is nearing the point of exhaustion. The published reports of the evidence taken by the Timber Commission which lately closed its investigations here, reveal the interesting fact that a large number of people personally interested in the timber trade, are entirely ignorant of the

narrow limits of our own timber resources, and have the vaguest possible idea of the state of things that prevails in the timber trade elsewhere. Those optimistic people who talk wildly about inexhaustible supplies of timber in this country, may be invited to consider the statistics published by the Lands Department or to reflect upon the evidence submitted by Mr. H. P. Kavanagh to the Timber Commission. According to this gentleman, who, as chief timber expert for Auckland district, may be fairly presumed to know what he is talking about, our stock of kauri will be exhausted in six or seven years' time, and our other timber in between 20 and 25 years. This I take to be as near a final and conclusive statement on the subject as we can hope to get; and even a professional optimist must admit that it is not a particularly pleasing outlook. But this is not the worst of it. When Mr. Milroy, secretary of the Kauri Timber Company, giving evidence before the Timber Commission, was asked what was going to happen after our own stock of timber gave out, he replied cheerfully enough that "in 30 years' time, assuming that our milling timber supplies were exhausted, he did not think it would be against the best interests of the Dominion to depend on timbers imported from abroad." But the cardinal point of the whole situation is the painful but indisputable truth that long before thirty years have expired New Zealand will find herself unable to draw upon other countries to supply her needs for the sufficient reason that they will require all, and more than all, their own timber for themselves.

THE WORLD'S OUTLOOK.

For, I repeat it most emphatically, the timber famine which has already begun to make itself felt in New Zealand is only one phase of a great change which is rapidly sweeping over the face of the world at large. In every land to which commerce has access to-day, the demand



SCIENTIFIC METHODS OF FORESTRY — AN AMERICAN FOREST CUT OUT UNDER GOVERNMENT REGULATIONS.

The young growth is uninjured and the brush is piled out for burning, thus obviating risk of casual fires.



ANOTHER REASON FOR SAVING THE BUSH.

A forest at the headwaters of a river, holding the snow and preventing its rapid melting during a thaw. The wholesale destruction of such a forest of course means that the rivers draining the slopes become liable to periodic floods.



THE KIND OF TREE-GROWING NEEDED HERE.

A Catalpa grove ten years old with a net value of 200 dollars (£40) an acre. The Catalpa and many other foreign trees will grow rapidly here, and will give a splendid return at an early age.

for timber is increasing out of all proportion to the supply, and this means that the timber famine which is already within striking distance of our own country, is destined soon to be literally and absolutely world-wide. On this point I have already compiled a good deal of evidence in my earlier articles; but to drive the argument home I must refer once more to the condition of the two countries which were endowed by Nature with forests more bounteously than any other land—the United States and Canada.

Of the rapid disappearance of timber in the United States, I have already spoken at length, but I venture to add a little further corroborative testimony. Mr. M. Seckendorff tells us, "We are now consuming our forests at the rate of about 45 square miles per day. We take from them, not counting the loss by fire, three and a-half times their yearly growth. We take 40 cubic feet per acre for each 12 cubic feet grown." For those who like to take their statistics seasoned with picturesque facts, I submit the following: "Secretary Will, of the American Forestry Association, has calculated that we consume each year enough timber to floor the entire State of Delaware; enough cooperage stock to build a rick four feet wide and four feet high extending from New York city to Colorado; enough firewood to make a one mile cube; and enough railway ties to build a railroad around the globe, with a side track across the Atlantic." To descend to figures again, the total yearly growth of the American forests is less than seven billion cubic feet. "We take from our forests yearly," says Mr. Seckendorff, "twenty-three billion cubic feet. Each year, therefore, we consume sixteen billion cubic feet more than can be replaced by Nature itself. In short, we are living on our capital. As forest fires and other destructive agencies, however, seem quite certain to off-set new growth, the end of our forests, unless present tendencies are checked, is indicated in from 20 to 30 years." In a

similar strain Mr. R. Cronau points out that the forest land of the United States has been reduced from 62 to 28 per cent of the total area. Even if the Americans do not increase the rate of consumption, their timber supply cannot last more than from 30 to 40 years. But Mr. Cronau thinks it likely that the consumption at the normal rate of increase will practically annihilate the American stock of timber within from 14 to 20 years. Thus he concludes that the Americans are dangerously near a timber famine, "that will strike at the very foundation of some of the country's most important industries"

WHAT WILL AMERICA DO?

What such a famine would mean to the industries, and therefore to the workers, of a great commercial country like America, it is very difficult to conceive. The timber trade—the fourth in rank of the American staple industries—pays about £30,000,000 a year in wages, and employs about 2,000,000 people. The timber utilised by the railroads for their sleepers represents, with renewals, an investment of more than £60,000,000. The mines use up 400,000,000 cubic feet of timber every year. The anthracite mines alone consume a cubic foot of timber for every ton of coal brought to the surface. In one great copper mine alone 25 feet of Oregon pine take the place of every ton of ore extracted. To descend to relatively unimportant industries, it may be enough to point out that the single item of matches means the destruction of 10,000 acres of forest every year. The consumption of timber for the manufacture of paper-pulp is another form of the demand for timber that has in recent years in America reached almost appalling dimensions. Mr. Whipple, the Forest Commissioner for New York State, has lately calculated that the American newspapers consume every year the equivalent of two billion feet of timber in the form of pulp. The average Sunday edition of the New York "World" requires just about 30 acres of timber to furnish

pulp for its paper; and the "World" is only one of 456 Sunday papers in the United States. Last year the United States Census Bureau issued a bulletin, in which it is stated that newspapers and periodicals in the United States used up in one year the timber from over 1,000,000 acres. "Every working day in the year the forests yielded approximately 1,765,000 feet of timber to be transformed into newspapers and magazines for the people of the United States." Perhaps some of these facts and figures may help us to understand what the American official authorities mean when they assert that a terrible timber famine is already imminent and near.

CAN CANADA HELP?

To casual or uninstructed observers it may seem at first sight that the United States could possibly evade the danger by doing what some people here expect New Zealand to do when the crisis comes—pass the burden along for someone else to bear. But I repeat that the time is rapidly approaching when neither New Zealand nor England nor the United States will be able to depend upon any other country's timber supply, because every country will want all the timber it can grow or save for itself. In America there was some years ago a general impression that when their own forests gave out the people of the United States could safely look to Canada; and this notion has, I observe, taken root and flourished even in New Zealand. While the Timber Commission was sitting in Auckland, it was confidently asserted by a witness who ought to have known better that "there was enough milling timber in British Columbia to supply the whole world for a hundred years." I was glad to see this statement promptly contradicted by one of our leading timber millers, who quoted the following interesting passage from an article on the prospects of the Canadian timber supply, written by a member of the faculty of

Forestry in the University of Toronto: "For years we have been talking about Canada's 'inexhaustible timber resources,' without knowing whether the statement was true or false. During the last ten years, though, enough information has been obtained to show that the amount of our standing timber of commercial sizes is very much less than we fondly imagined it was. The accessible saw-log timber is estimated by Dr. Fernow at six hundred billion feet board measure—enough to supply the United States for 15 years." Now, Dr. Fernow is one of the most eminent authorities on forestry in America, and if he tells us that Canada has no more than enough timber to supply the demands of the United States for 15 years, we may surrender at once all our vague notions about "inexhaustible supplies" and our vain hope of being able to get all the timber we want from Canada. As a matter of fact, Canada has taken the alarm already, and is now contemplating legislation to check the destruction of her forests and the unrestricted export of timber to supply the needs of her American neighbours. And this is the attitude already assumed by practically every other country in the world, in view of the constantly increasing demand upon its stock of indigenous trees.

THE COMING CRISIS.

So far as we in New Zealand are concerned, we must therefore look forward to the necessity for facing the coming timber famine with our own strength alone. And what such a famine might really mean to us all I have endeavoured already to indicate. Perhaps the most instructive commentary that I can supply upon my arguments is contained in a statement recently published by one of the foremost authorities on timber in the world—Mr. Gifford Pinchot, the Chief of the Forest Service of the United States. He asserts that "the United States has already crossed the verge of a timber famine so severe that its blighting effects will be felt



THE DESOLATION OF THE CLEARING.

There are 6,000,000 acres of barren land ruined by reckless cutting round the great Canadian Lakes alone.

in every household in the land." He estimates that, at the present rate of consumption, the supply of timber in the United States will be exhausted in 30 years. The lumber business, now the fourth greatest industry in the colony, will disappear. All forms of building industries will suffer. Mining will become vastly more expensive, and there will be a corresponding rise in coal and iron. The railways, unless a substitute for the wooden sleeper is found, will be profoundly affected, and the cost of transportation will rise. Farming will be more expensive. Water power for lighting, manufacturing, and transportation will be affected. "Irrigated agriculture will suffer most of all, for the destruction of the forests means the loss of the waters as surely as night follows day. With the rise in the cost of producing food, the cost of food itself will rise. Commerce in general will necessarily be affected by the difficulties of the primary industries upon which it depends. In a word, when the forests fail, the daily life of the average citizen will inevitably feel the pinch on every side, and the forests have already begun to fail." Such is the prospect that the most eminent expert in America depicts for its people, and such, in a modified degree, must be our own experience if we persistently refuse to heed such warnings as these, and to prepare against the evil day while yet there is time.

OUR ONLY HOPE.

Enough of the Evils of Deforestation; and now once more for the remedy! I have shown already in these articles not only that it is a national duty to replant the forests as they are cut down, but that the work of Reforestation and Afforestation can be carried out at a large financial profit to the individual or the State. The experience of other countries has proved this incontestably, and the few years during which our Forestry Department has been making its little tentative efforts at tree-growing here, have shown that

even on a very moderate expenditure a regular and substantial return could be speedily secured for such an investment of public money. The evidence on this point that I have compiled and set before my readers should, I venture to believe, convince any impartial person that a national system of Afforestation, conducted on a large scale, and managed on scientific lines, could not only avert for us the many evils that follow on the destruction of the native bush, but could obviate the otherwise inevitable timber famine, furnish profitable employment for a large number of workers, and provide a highly lucrative investment for a considerable amount of public capital.

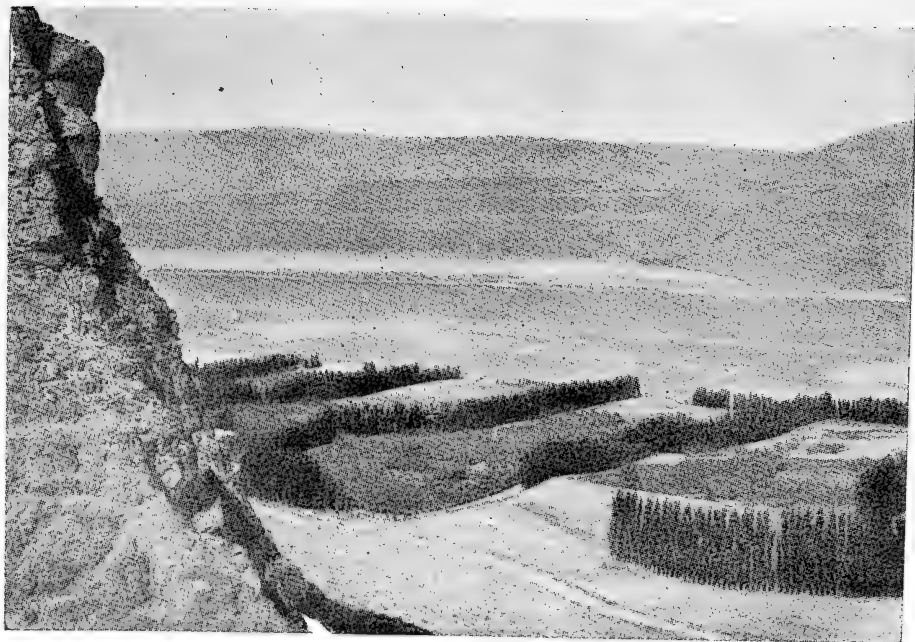
Probably I have said enough to justify my contentions, though I have by no means exhausted the list of possible arguments in favour of reforesting the country. I might have referred to the value of our water supply as a source of electrical energy, and the need for conserving it; for surely, at a time when the whole world is striving to utilise water power to generate electricity, it is a suicidal policy for a country so generously endowed in this way to risk the very existence of rivers and waterfalls by recklessly destroying the forests that provide the reservoirs, from which these streams are fed. And I might have enlarged upon the value of the bush as a means of checking and controlling the movement of sand, and the urgent necessity for planting and replacing the bush in districts where, as along the West Coast of the North Island, sand drifts are constantly encroaching upon valuable land. The well-known example of France and the large revenue that she has derived for many years from the plantation of her sand-dunes, should be good enough precedent for any colonial government to follow. And I might have quoted the recently published report of the British Commission on Erosion and Reforestation to show that at Home a na-

tional scheme of Afforestation on a gigantic scale is now contemplated as a remedy for unemployment. But these are in a sense side issues, and I am willing to stake the case for Reforestation and Afforestation in New Zealand solely on the pleas that I have already so often recapitulated—the rapid disappearance of our native bush, the urgent necessity for replenishing our stock of timber, the imminence of the approaching timber famine, and the terribly devastating effects of the extirpation of forest trees, as seen in the denudation and erosion of hill sides, the destruction of fertile soil, the drying up of streams, the silting up of rivers and harbours, the regular recurrence of disastrous floods, and the deterioration in the climatic, meteorological, and hygienic sense of every country, which has once sacrificed its natural heritage of trees without making any adequate effort to replace them.

A LAST APPEAL.

What then shall we do to combat these dangers? The answer is indicated, I hope with sufficient clearness in all that I have already written. We have a Forestry Department and we have already inaugurated a system of afforestation. We must extend our operations and spend more money over the work than before. We must not be content with a few thousand acres, but we must lay our plans on a generous scale, for the establishment in all parts of the country of large plantations of quick growing and valuable timber trees. We must as far as possible protect our State forests against fire, by employing large numbers of rangers; for though this may seem an expensive process, the result will amply repay us. We must prevent the indiscriminate clearing of the bush on land that is really unfit for settlement, and under no circumstances should we permit timber to be cut away along the upper courses and headwaters

of our rivers. But above everything else we must plant, plant, plant, and encourage everybody who owns land to plant, by every means in our power. Arbour Day is still in theory a public institution here, but it sadly needs the aid of a little popular enthusiasm. Of course, the indiscriminate planting of worthless trees in unsuitable localities is simply waste of time. But our Forestry Department is in a position to circulate any quantity of useful information on such subjects, and to control and direct such efforts at afforestation or reforestation as the people may choose to make. This great work, as I have already tried to show, is primarily the function of the State; and what money the State expends upon it will soon be repaid tenfold by our immunity from the disastrous losses that deforestation necessarily entails. But the fact that Government has already taken up this work does not relieve individual citizens of their responsibility in the matter. Every man who possesses a piece of land should reflect upon these memorable words of Stephen Girard: "If I knew that I must die to-morrow, I would plant a tree to-day." For even if an enlightened sense of self interest does not teach him to regard tree-planting as one of the most profitable occupations he can take up and one of the most lucrative ways in which he can turn his land to account, every intelligent citizen should realise that he owes it as a duty to his neighbours, his children and his country, to conserve our forest wealth and to replace our trees at least as rapidly as they are cut away. Even on purely selfish grounds we must admit all this, because even within our own day and generation the timber famine is almost upon us, and the evils that I have endeavoured to describe are already manifesting themselves on every hand. But on such a question as this I do not think that I need appeal to self-interest alone. Even though the



THE MENACE OF DRIFTING SAND.

A patch of fertile soil rescued from the encroaching desert (Columbia River, U.S.A.). The only way in which the leagues of shifting sand along our own West Coast can be controlled and prevented from submerging the adjacent land is by systematic planting.



ANOTHER ITEM IN OUR FORESTRY ACCOUNT — DEBIT SIDE.

Portion of the expensive harbour works at the mouth of the Wanganui. This breakwater is being constructed at the cost of many thousands of pounds for the purpose of compelling the river to scour out the silt that has been washed down by the floods and constantly threatens to choke the entrance.



THE AFTERMATH OF THE AXE.

injuries that this country must incur through the destruction of the native bush must bear more heavily upon the next generation than on this, and even though the benefits of Afforestation or Reforestation must be secured by our sons and grandsons rather than by ourselves, I do not believe that there are many New Zealanders ready to ask that singularly sordid and futile question "what has Posterity done for us that we should undergo sacrifices and hardships for its sake?" I prefer to believe that in this beautiful land, the vast majority of men and women feel as keenly as I do the responsibility entailed upon us all of leaving our natural

heritage no less beautiful and healthy, and fertile and productive; than we found it. To those who feel the truth of this, the case for Afforestation and Reforestation needs no elaborate argument to enforce it. And even those who pride themselves on taking a sternly practical view of life, and who refuse to prefer romantic sentiment to material gain may well consider if on such evidence as I have laid before them, the policy of afforestation is not urged upon them only by a sense of public duty, but by a sense of the necessity for that self-preservation which, as we are proverbially and justly told, is the first Law of Nature.



